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AUTHOR Tucker, William H.
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ABSTRACT

Five questionnaires were administered to a group of subjects on two separate occasions. The principal concerns were the following: (1) to find evidence for the existence of stable (i.e., over testings) circular triads, (2) To investigate the appropriateness of the additive difference model, if such stable circularities are found, and (3) If such evidence is not found, to investigate the intransitivity-as-inconsistency explanation by exploring the relationship between circular triads and changes in response to individual items over the two administrations. With the exception of one subject on one questionnaire, no such evidence for stable intransitivities was found. Consequently, the inconsistency explanation was investigated by a factor analysis of nine variables derived from the subjects' choices. These variables were measures of consistency, transitivity and discrimination among stimuli. Results of this analysis suggest that the assumption of circular choices as synonymous with inconsistency is upheld for three of the five questionnaires. (Author/MS)

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AN INVESTIGATION OF INTRANSITIVE CHOICE BEHAVIOR

William H. Tucker
Princeton University

Prepared in connection with research sponsored
by the Personnel and Training Research Programs
Psychological Studies Division, Office of Naval Research
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Princeton University, Princeton, New Jersey
Project on "Mathematical Techniques in Psychology"
Principal Investigator: HAROLD GULLIKSEN

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13. Abstract (Continued)

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Accordingly, five questionnaires were administered to a group of subjects on two separate occasions. In each case the subjects for the second administration were the same individuals who had completed the questionnaire the first time, so that data could be obtained on the responses of the same subject to the same pairs of choices on two distinct administrations. The principal concerns were the following:

1) To find evidence for the existence of stable (i.e., over testings) circular triads.

2) To investigate the appropriateness of the additive difference model, if such stable circularities are found.

3) If such evidence is not found, to investigate the intransitivity-as-inconsistency explanation by exploring the relationship between circular triads and changes in response to individual items over the two administrations.

With the exception of one subject on one questionnaire, no such evidence for stable intransitivities was found.

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by

William H. Tucker

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AN INVESTIGATION OF INTRANSITIVE CHOICE BEHAVIOR

Abstract

Individuals are often asked to make choices from all possible pairs of a set of stimuli. For each pair they may have to select the alternative which is heavier, more preferable, more favorable to Blacks, etc. Intransitive or circular choice behavior occurs when an individual selects stimulus A over B, B over C, and then C over A. Such a pattern of choices is referred to as a circular triad. Since most theories of choice assume transitivity as a basic principle of human choice behavior, explanation of the occurrence of intransitivities is a crucial problem in the behavioral sciences.

Three types of explanation have been posited for the existence of circular choices. One suggests that the subject is not taking the necessary effort to make careful choices; that is, intransitivities occur due to the individual's sloppiness or carelessness. Since subjects typically seem to make choices in a conscientious manner, this outlook is not very plausible. Another explanation is that intransitivities arise from the close proximity of stimuli on an underlying linear continuum. Thus, even though the subject is conscientious, the stimuli may in some cases be too similar to distinguish. This explanation implies that there is really no difference between intransitivity and inconsistency - the reversal of responses by a subject over two administrations of the same pairs of choices.

The third type of explanation concerns the development of a choice model which might account for intransitive behavior. Some attempts at such a

model focus on the multidimensional nature of the stimuli, circularities being caused by the way in which a subject combines ratings on the separate dimensions to yield an overall choice between the pair of alternatives. Specifically, the additive difference model developed by Tversky (1969), drawing on earlier work by May (1954) and Morrison (1962) suggests that stable circular triads (i.e., intransitivities occurring in exactly the same way) would be expected from two administrations of the same choice pairs.

Accordingly, five questionnaires were administered to a group of subjects on two separate occasions. In each case the subjects for the second administration were the same individuals who had completed the questionnaire the first time, so that data could be obtained on the responses of the same subject to the same pairs of choices on two distinct administrations. The principal concerns were the following:

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AN INVESTIGATION OF INTRANSITIVE CHOICE BEHAVIOR

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CHAPTER I

INTRODUCTION TO THE PROBLEM

If an individual prefers a stereo set to a new suit, and a new suit to a television, is it certain that he prefers a stereo set to a television? Previous investigation of human choice behavior has shown that individuals often make the enigmatic response of television over stereo. This is an example of intransitivity of choice in which A is chosen over B, B is chosen over C, and then C is picked over A. Since, as we shall see, most theories of choice assume transitivity as a basic principle of human behavior, explanation of the occurrences of intransitivity is a crucial problem in the behavioral sciences.

1.1 Transitivity and Rationality

Before considering any such explanations let us speculate on why transitivity of choice is so often a necessary axiom to theoretical developments of choice behavior. First of all, from a purely philosophical viewpoint, transitivity is usually considered one of the essential criteria of a rational decision. Edwards, Lindman and Phillips (1965) in their reading of the philosophical literature on rationality found that "...20 or 30 criteria by which a rational decision can be distinguished from an irrational one have been proposed and seriously studied" [p. 272]. Although considerable disagreement exists about the necessity of many of these criteria, they state that one of the few uncontroversial principles of rationality is the principle of transitivity.

Davidson, McKinsey and Suppes (1955) consider a set K of alternatives and the relations E, which holds between two alternatives that are equivalent

in preference, and P , which holds when one alternative is definitely preferred to another. They then define a rational preference ranking as the triple < K,P,E > if and only if

1. The relation P is transitive.
2. The relation E is transitive.
3. If x and y are in K , then exactly one of the following:

   xPy, yPx, xEy .

While the third condition merely requires that it be possible to compare the alternatives, the first two again establish a formal condition of transitivity as necessary for rationality.

Naturally, the above normative considerations do not in any way deny the existence of intransitivities. Rather, they imply that

> ...we ordinarily would admit that such intransitive patterns of judgment or decision are mistakes, and that truly rational choices would be transitive. In fact, a man who was deliberately and systematically intransitive could be used as a money pump. You might say to him: "Here, I'll give you pork chops. Now, for a penny I'll take the pork chops back and substitute lobster for them." Since he prefers lobster to pork chops, he accepts. Next you offer to replace lobster with steak for another penny, and again he accepts. You complete the cycle by offering to replace steak with pork chops for still another penny, and since he prefers pork chops to steak, he again accepts, and thus is three cents poorer, back where he started, and ready for another three cent round [Edwards, Lindman & Phillips, 1965, p. 273].

While Edwards and his associates polemicize convincingly against making intransitive decisions, they categorize any violation of transitivity as a "mistake" and thus imply that there is no possible descriptive model for their explanation. Indeed, they conclude that the fact that "...we have never met such a money pump suggests that no one is in fact deliberately and systematically intransitive" [p. 273]. Personal acquaintances

to the contrary, the possibility of systematic intransitivities will be one of the major concerns of this investigation.

1.2 Definition of Preference

In the Davidson, McKinsey and Suppes formulation above, P and E correspond to a strict "preferred to" (>) and an "indifferent to" (=) relation respectively. The preference relation is often formulated as the combination of these two ($\geq$). In this case if preference is transitive, then each of its components must be transitive. We shall only consider the relation of strict preference here.

Transitivity of indifference has long been doubted and does not seem to have the same intuitive appeal as transitivity of strict preference. Early psychophysical investigations of Weber and Fechner were concerned with determining the least difference between two stimuli which can be noticed (Fullerton & Cattell, 1892). Thus any trial composed of two "just noticeable stimuli" and some stimulus between these two (on the underlying physical continuum) would produce an intransitive indifference relation.

Luce (1956) quotes Armstrong as stating

> ...the nontransitiveness of indifference must be recognized and explained on (sic) any theory of choice, and the only explanation that seems to work is based on the imperfect powers of the human mind whereby inequalities become recognizable only when of sufficient magnitude [p. 179].

Empirical evidence from psychophysics furnishes support for this view. Luce considers an individual who prefers a cup of coffee with one cube of sugar to one with five cubes. Now, if there are 401 cups of coffee with $(1 + i/100)x$, $i = 0,1,...400$, x = the weight of one sugar cube, the subject will be indifferent between any cup i and cup $i + 1$, but not between $i = 0$ and $i = 400$.

Both Luce (1956) and Krantz (1966) have pursued the implications of a preference system in which the indifference component may be intransitive.

1.3 Transitivity and Scaling

In addition to its necessity as a formal condition for rationality, there is a still more compelling basis for the transitivity assumption in actual empirical work. Often we seek to create some sort of scale such that the number assigned to a given alternative on this scale is greater than the number assigned to some other alternative if and only if the former is preferred to the latter. In other words we seek to map the set of empirical preference relations on these objects onto some subset of the real number system. Since the number system is clearly transitive, there can be no numerical representation if the preferences are not transitive. As Quandt (1956) has pointed out in discussing transitivity, "...without this axiom one can construct neither an ordinal preference map nor a cardinal utility index" [p. 507].

Since many individuals do not make the same choice each time they are faced with the same pair of alternatives, preference is often defined in a probabilistic fashion, and one alternative is said to be preferred to another if it is chosen over the other more than 50 per cent of the time. If $p(x,y)$ is the probability that x is chosen over y, then x is preferred to y if and only if $p(x,y) > 1/2$. Consequently transitivity may also be defined in a probabilistic manner as opposed to the algebraic transitivity which we have been discussing above. Marschak (1960) reviews three types of probabilistic or stochastic transitivity. Strong stochastic transitivity states that if x is preferred to y and y is preferred to z, then x

will be preferred to z at least as much as the greater of the above pair of preferences. Symbolically,

$$p(x,y) \geq 1/2,\ p(y,z) \geq 1/2 \text{ implies } p(x,z) \geq \max [p(x,y),p(y,z)] .$$

Moderate stochastic transitivity states that x will be preferred to z at least as much as the smaller of the pair, or

$$p(x,y) \geq 1/2,\ p(y,z) \geq 1/2 \text{ implies } p(x,z) \geq \min [p(x,y),p(y,z)] .$$

Finally, weak stochastic transitivity implies only that x will be stochastically preferred to z . That is,

$$p(x,y) \geq 1/2,\ p(y,z) \geq 1/2 \text{ implies } p(x,z) \geq 1/2 .$$

A brief survey of the major measurement models will show that some form of transitivity is either a basic assumption or an immediate consequence of the basic assumptions. The literature on conjoint measurement (Krantz, 1964; Luce, 1966; Luce & Tukey, 1964; Tversky, 1964, 1967a) in each case begins with an axiom requiring algebraic transitivity of some empirical relation on the objects or alternatives in order to develop the model. Tversky and Russo (1969) show that if strong stochastic transitivity is defined so that strict inequality in both hypotheses entails strict inequality in the conclusion, then it is equivalent to the assumption of simple scalability. Simple scalability exists if there are functions F and u such that for all alternatives,

$$p(x,y) = F[u(x), u(y)] ,$$

where F is increasing in u(x) and decreasing in u(y) . Thurstone's (1927a) Case V and Luce's (1959) choice model both depend on a special case of the above equation in which F is a function of the difference

between u(x) and u(y):

$$p(x,y) = F[u(x) - u(y)] .$$

Since Tversky and Russo derive their stronger formulation of strong stochastic transitivity from the above equation, it is evident that it (SST) also may be a suitable assumption from which to develop Thurstone's Case V or the Luce model. Morrison (1962, Appendix A) has shown how moderate stochastic transitivity can be derived from Thurstone's Case III, and Morrison (1963) and Luce and Suppes (1965) both present further relationships between various choice models and the different types of stochastic transitivity.

1.4 Intransitivity as Random Behavior

Despite the obvious appeal of transitivity as a basic assumption about choice behavior, intransitivities frequently occur in empirical work. Typically data in such work are collected by the method of paired comparisons in which the set of stimuli or alternatives is presented to each subject or judge in all possible pairs. Thus for n stimuli there are $n(n-1)/2$ possible pairs. In this way transitivity can be investigated by looking at each stimulus triple; intransitive triples are also referred to as circular triads. The computational details of circular triads were first discussed by Kendall and Smith (1940) in which they derive expressions for the maximum possible circular triads for n stimuli presented in a paired comparisons schedule. Kendall (1962) presents the derivation of formulae for computing the total circular triads (TCT's) made by an individual in a comparisons task (see Appendix I). He also presents a statistical test to determine whether the number of TCT's made by a given subject is significantly less than the number of TCT's expected if the subjects were responding at random to the stimuli.

Three explanations have been posited for the existence of intransitivities in paired comparisons data. Two of these will be discussed below, while the remaining one will be developed in Chapter II. The first is that the subject may be making choices purely at random. While it would seem that this hypothesis is ideally suited for investigation by Kendall's statistical test described above, Morrison (1962) has pointed out an interesting problem in this approach. Suppose that a subject sets out with the "diabolic" intent of producing as many circular triads as possible.

> ...He accomplishes this by predetermining his complete paired comparison choices for all stimuli and then choosing on the basis of this internalized paired comparisons structure at every opportunity. Not all the triples of pair-wise choices can be intransitive if...(the number of stimuli)...is greater than three, since each choice is included in a number of triples [p. 11].

For n stimuli there are $\binom{n}{3}$ total number of triads, while the maximum number of circular triads that could be made is $n(n^2 - 1)/24$. Thus the maximum proportion of circularities is given by

$$\frac{n(n^2 - 1)/24}{\binom{n}{3}} = \frac{n(n + 1)(n - 1)/24}{\frac{n(n - 1)(n - 2)}{6}} = \frac{n + 1}{4(n - 2)} .$$

As n gets very large, this ratio obviously approaches .25. In other words the diabolic subject through his systematic choices can ensure that 25 per cent of the triads will be circular. Now Kendall's test is based on a chi square approximation to the number of circularities expected from random responses. If the number of circularities from maximum to minimum, is plotted on the abscissa, then relatively low frequencies falling past a cutoff point on the right tail of the distribution imply a rejection of the "random" hypothesis.

Consequently, there would be no way, utilizing Kendall's test, to distinguish between the randomly intransitive and the deliberately intransitive individuals.

1.5 Intransitivity as Inconsistency

Another explanation suggests that intransitivities arise from the degree of separation of two stimuli on an underlying linear continuum. Whereas the first explanation assumed that the stimuli are distinguishable and the subject is not paying attention, this one supposes that the stimuli are similar and the subject makes a sincere effort but has difficulty telling them apart. This possibility is especially appealing since it allows the retention of transitivity as an assumption about preference behavior and treats circularities as errors or mistakes resulting from the subject's imperfect discriminative abilities. Typical of this outlook is Hill (1953):

> If the rationale underlying the method of paired comparison scale construction is valid, then the occurrence of inconsistent judgments of objects should increase as the difference between those objects on the underlying continuum decreases. In other words the greater the difference between objects with respect to the attribute being judged, the less likely these attributes are to be judged inconsistently [p. 565].

In support of this contention Hill showed that an inverse relationship existed between the frequency of occurrence of a circularity and the scale distance between the extreme members of an item triad. He concludes that "...the greater the psychological distance between objects, the less likely the objects are to be judged inconsistently" [p. 566]. Interestingly, Hill uses the term "inconsistency" rather than circularity or intransitivity. Such terminology implicitly precludes any explanation of circularities which might be "consistent" with some criteria.

Other writers have also made the assumption that intransitivity may be equated with inconsistency, and that a circular triad produced by the

subject may, in some sense, be considered an "error." Koslin and Pargament (1968) and Koslin, Suedfeld and Pargament (1968) both used circular triads as a measure of discrimination errors by subjects, "...assuming that the preferences among stimuli form a linear scale, and that circular triads arise in practice because subjects cannot distinguish stimuli from one another" [Koslin & Pargament, 1968, p. 6].

Sadacca (1962) first reviews a number of measures of intraindividual variability. He points out that the most frequent index of such variability is the number of changed item responses when a particular test or inventory is administered to the same individual on two occasions. This variability is usually treated as unreliability and assigned to error variance (Fiske & Rice, 1955). Sadacca himself then uses circular triads as an operational measure of "...inconsistency of judgment, intra-individual variability being inferred by the lack of consistency in responses" [1962, p. 13]. Thus he assumes that there is really no basic difference between circular triads and reversed responses over testing occasions--each is a measure of intraindividual variability. By factor analyzing the circular triad scores obtained from paired comparisons schedules using a number of different types of stimuli, Sadacca concludes that such inconsistency is a general trait. "...subjects who were inconsistent in making judgments of one set of stimulus pairs tended to be inconsistent in judging other sets of stimulus pairs, regardless of the type of judgment and kind of stimulus involved" [1962, p. 148].

A number of investigators have pursued the relationship of intransitivities (assumed to be inconsistencies in the sense of Hill and Sadacca) to other variables. Gulliksen, Saunders and Tucker (1954) found a curvilinear relationship between the number of circular triads produced and the

grades of college students, with the best grades being made by students at about the 75th or 80th percentile of consistency. However, they found no correlation between such response consistency scores and other predictors of academic achievement. Hills and Raine (1958) found essentially no correlation between circular triad scores and grades in law school or scores on the LSAT.

Some researchers have even ascribed moral overtones to the production of intransitivities. Benson (1958) claims that "...if the respondent displays circularity of reply in making choices, one or more of the choices is invalid..."[p. 286] and that "...TCT may reflect the attentiveness or honesty with which respondents make their choices" [p. 287]. Accordingly, Benson describes a study comparing the consistency of subjects taken from Annandale Reformatory with subjects from Drew University.

> The purpose of this study was to see whether TCT can be used to differentiate between reliable and unreliable respondents. Those who fabricate their replies may be unable to do so as consistently as if they reply honestly, following the natural order of their personality traits. The hypothesis tested is that reformatory inmates are more inconsistent than college students...[p. 287].

Since the differences between these groups were not statistically significant Benson concludes that "...TCT is a variable of little usefulness in distinguishing between paired comparisons replies of criminals and noncriminals, and by implication, is of little value as a check upon honesty."

Davis (1957) also suggests the possibility of measuring how

> ...conscientiously a subject fills out a questionnaire by the use of circular triads, because the unconscientious subject would make a great many. It might also be possible to measure how much a subject fakes a questionnaire because, although the subject can fake some items consistently, he probably would not be able to fake a great many items without making circular triads [p. 22].

Curiously the Davis study found a correlation of .46 (.01 lower bound = .16) between the number of circular triads made by a subject and his score on the McClelland Need Achievement Thematic Apperception Test. Davis interprets this finding as indicating that subjects with low need achievement perhaps made a "...more conscientious effort to state their preferences" [1957, p. 24]. The implicit assumption is that a subject responding "conscientiously" will produce fewer intransitivities than one who is careless.

CHAPTER II

MODELS FOR INTRANSITIVE CHOICES

Some researchers have suggested that circularities are the product neither of random responses nor of inability of the subject to discriminate. Accordingly they have worked on the development of descriptive models focusing on how and when such circularities will occur. Attempts at such models have taken a number of directions.

2.1 Circular Triads and Stochastic Transitivity: the Luce Model

The Luce model views circular triads as an epiphenomenon due to the stochastic definition of preference. It is assumed (Luce, 1959) that the three pairwise choices constituting a triad are statistically independent and thus the probability of a circularity of the type x over y, y over z, z over x is merely the product $p(x,y)p(y,z)p(z,x)$.

The Luce model has as its basic assumption the choice axiom which states in part

> Let T be a finite subset of U such that, for every $S \subset T$, P_S is defined. If $p(x,y) \neq 0,1$ for all $x,y \in T$, then for $R \subset S \subset T$,
>
> $$P_T(R) = P_S(R)P_T(S) \qquad (1)$$

That is, the two choices--choice of a particular subset S from the set of stimuli T, and choice of a further subset R from the set S--are independent. In other words the probability of choosing R does not depend on how T is partitioned to form S . From this axiom it may be shown (for details, see Luce, 1959, p. 9, Lemma 3) that

$$\frac{p(x,y)}{p(y,x)} = \frac{P_T(x)}{P_T(y)} \qquad (2)$$

With this result Luce can now prove a theorem which states

If the choice axiom holds for $\{x,y,z\}$, and if none of the pairwise discriminations is perfect, then

$$p(x,y)p(y,z)p(z,x) = p(x,z)p(z,y)p(y,x) \qquad (3)$$

since, if $T = \{x,y,z\}$

$$\frac{P_T(x)}{P_T(y)} \cdot \frac{P_T(y)}{P_T(z)} \cdot \frac{P_T(z)}{P_T(x)} = 1,$$

then by (2),

$$\frac{p(x,y)}{p(y,x)} \cdot \frac{p(y,z)}{p(z,y)} \cdot \frac{p(z,x)}{p(x,z)} = 1,$$

and the theorem follows immediately. However, the left hand side of (3) is just the probability of obtaining a circularity of the type x over y, y over z, z over x, while the right hand side is the probability of the opposite type of circularity, x over z, z over y, y over x. Thus the Luce Model predicts what Morrison (1963) terms symmetric intransitive triads (SIT)--the frequency of intransitive triads which cycle in one direction should be equal to the frequency of those which cycle in the opposite direction.

2.2 Circular Triads and Stochastic Intransitivity: the Coombs Model

Coombs' (1964, Chapter 5) development of the unfolding model assumes that an individual has an ideal point on the continuum underlying his choice, and in each case he makes a decision by comparing the distances of the two alternatives from his ideal point, and choosing the closer. However, a pair of stimuli

do not necessarily lie on the same side of the ideal point. A unilateral pair is one in which the stimuli are both on the same side of the ideal, while a bilateral pair is one in which they are on opposite sides. Now, variability (i.e., a probability distribution over the ideal point) in the location of the ideal will not affect the consistency of judgment on the unilateral pairs, but it will affect the bilateral pairs. As Coombs describes it the two bilateral distributions are "...rolling over each other in opposite directions as the ideal varies, whereas a pair of unilateral distributions slides back and forth locked tightly together" [1964, p. 108].

The concept of laterality now leads to three distinct types of triples. A unilateral triple is one in which all three stimuli are on the same side of the ideal. A bilateral adjacent triple and a bilateral split triple are instances in which one of the three stimuli is on the opposite of the ideal from the other two. In the former case this single stimulus is either first or last in the ordering of the triple with respect to absolute distance from the ideal, while in the latter case the single stimulus comes between the other two on this ordering. Thus in a bilateral adjacent triple the first and last stimuli always constitute a bilateral pair with one unilateral and one bilateral pair between them, while for bilateral split triples, the first and last stimuli constitute a unilateral pair with two bilateral pairs embedded between.

Now consider the effect of variability of the ideal point on each type of triple. The unilateral triple, being composed of three unilateral pairs, naturally is not affected at all. However, the bilateral triples are affected since they both contain embedded bilateral pairs. If the bilaterality is

adjacent, variability of the ideal will cause increased inconsistency in the pairing of the two extreme stimuli of the triad, and hence the degree of stochastic transitivity will decrease. However, if the bilaterality is split there will be greater inconsistency in the judgment of the nonextreme pairings and no effect on the extreme pair, tending to increase the degree of stochastic transitivity.

Coombs performed an experiment designed to test predictions derived from the above analysis (see Coombs, 1958 or 1964 for details). In general the results tend to confirm these predictions. However, the data were not collected by the method of paired comparisons. Instead paired comparison choice probabilities were estimated from the subject's rankings of subsets of four stimuli (there were a total of twelve stimuli in the investigation).

Of course the Coombs model is applicable only to situations in which transitivity is defined stochastically, and even here, the model will not apply to violations of weak stochastic transitivity.

2.3 Psychological Dimensions

Models dependent upon a multidimensional characterization of the subject's judgments have also been posited as a rationale for circular triads. However, before proceeding to a discussion of these models, let us clarify what is meant by the use of the term "dimension."

Tversky and Krantz (1969a) point out that the concept of a psychological dimension has been used in several different senses in the literature. One meaning attributed to it is a variable that can be experimentally manipulated, such as the frequency of an auditory stimulus or the length of a geometric figure. From a psychological standpoint this use of the term dimension is neutral,

since it refers to the physical characterization of stimuli, not to the way in which they are perceived. A second meaning of the concept of dimension is some variable that cannot be measured or observed directly, but is expressed in terms of a number of directly observable variables. Some factor analytic definitions, such as Spearman's g or Thurstone's primary abilities are examples of dimensions defined as combinations of measurable variables such as test scores. In this case the actual measurement procedure (though not, as Tversky and Krantz point out, the interpretation of the dimensions) is not dependent on any testable psychological assumptions. Instead it is a method of data reduction--a large number of correlated variables is expressed in terms of a smaller number of uncorrelated ones.

Finally, the most interesting meaning of the term dimension refers to the factors along which stimuli are perceived. "...In speaking of hue, saturation, and brightness as dimensions of color space, of potency as a dimension of semantic space, it is typically implied that these dimensions serve as organizing principles in the perception of colors or words" [Tversky & Krantz, 1969a, p. 38]. Of course this does not imply that dimensions of this type are necessarily different from those described in the first definition above. The frequency of a sound, the length of a line, or other experimentally controlled variables may, indeed, have some functional relationship to the organizing principles extracted when a subject perceives the given stimuli.

2.4 Multidimensional Models

Prior to the actual development of a multidimensional model which might underlie intransitivity, some investigators in allied fields (to choice behavior) had made allusions to the possibility of such a model. McCulloch (1945)

investigated circularities in neural switching circuits and suggested that "...circularities of preference, instead of indicating inconsistencies, actually demonstrate consistency of a higher order than had ever been dreamed of..." [p. 93]. Rapoport (1949), in his consideration of the intransitivity of the "peck right" relation in a society of animals, formulates the problem thus:*

$A > B$ if and only if $f(A,B) > f(B,A)$

$B > A$ if and only if $f(B,A) > f(A,B)$

where f is a certain function, whose "...arguments are the respective 'characteristics' of the individuals involved in the peck right relation" [p. 186]. Rapoport goes on to point out that transitivity will always hold if f is a function of a single variable, but if f is a function of more than one variable (i.e., a multidimensional situation), then f may easily be constructed so that an intransitive pecking relation results.

The first more detailed exposition of this type of model is due to May (1954). He considers the choice alternatives in terms of their "components" and suggests that a given stimulus may be characterized as a vector $X_i = (x_{i1}, x_{i2}, \ldots, x_{im})$ whose elements correspond to ratings on the m components or dimensions. A circular triad may now arise depending on the way in which an individual combines ratings on these separate dimensions to yield an aggregate preference between two stimuli. For example, consider a paired comparison schedule, administered to a group of students, which requires each one to indicate his preference among pairs of restaurants. In this case the salient dimensions might well be postulated as follows:

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*$A > B$ is read A pecks B.

I How good the food is

II How late the restaurant is open

III How inexpensive the food is.

Possibly there are three restaurants which some particular student rates in the following manner:

	I (Good)	II (Late)	III (Inex)
Student Center	medium	high	low
PJ's	low	medium	high
Annex	high	low	medium

According to May, if this student makes his choices on the basis of which stimulus has a higher rating on the greater number of dimensions, then a circular triad of the form, Annex preferred to Student Center, Student Center preferred to PJ's, PJ's preferred to Annex will result. However, May ignores the fact that if selection is based on the criterion that only the difference between ratings of low and high are meaningful (i.e., comparison of high-medium and medium-low are ignored), the opposite circular triad will be obtained.

To investigate his model empirically, May had 62 college students make paired comparison choices from three hypothetical marriage partners. The first hypothetical partner was described as very intelligent, plain looking and well off; the second as intelligent, very good looking and poor; and the third as fairly intelligent, good looking and rich. The subjects were told that the prospects were to be considered acceptable in every other way, none being so poor, plain or stupid as to be eliminated. The results are not reported in any detail and May is rather inconclusive. He suggests that "...where choice

depends on conflicting criteria, preference patterns may be intransitive unless one criterion dominates" [May, 1954, p. 7].

The political science literature contains an interesting problem termed the legislative paradox which is quite similar to the above analysis in its formal aspects. However, May's explanation refers to the circularities found in individual preferences, while the legislative paradox concerns the circularity of preference when pairs of alternatives are presented to a group and a decision is made on each pair through majority vote. McGarvey (1953) has proven a theorem which states that given any preference pattern--transitive or intransitive--a group of individuals exists with transitive individual preference orderings such that the group preference pattern as determined by the method of simple majority decision is the given preference pattern.

Savage (1951; see Luce & Raiffa, 1957, pp. 280-282) has suggested the minimax risk criterion as a model for individual decision making under uncertainty. If this model is used in making decisions between pairs of acts, intransitivities may result from it. The situation to which it applies occurs when the result of an individual choice depends upon what "state of nature" exists subsequent to the choice. Each act or choice (A_i) yields a different payoff contingent upon which state (S_i) turns out to be the true state. Savage defines "risk" or "regret" of a particular choice given the occurrence of some state as the difference between the payoff for that choice and the highest payoff for the particular state of nature. For example, consider the following matrix of payoffs:

	S_1	S_2
A_1	10	4
A_2	2	8

If S_1 is the true state of nature, then there is no risk or regret if A_1 is chosen since the individual has obtained the highest possible payoff (10) given that S_1 occurs; but there is the risk of eight (of whatever units in which payoffs are considered) if A_2 is chosen--the difference between the maximum payoff in that state and the payoff obtained from the choice made. Thus the above payoff matrix leads to the following regret matrix:

	S_1	S_2
A_1	0	4
A_2	8	0

The minimax risk proposed by Savage suggests that the alternative be chosen which minimizes the maximum risk. In this case it would be A_1 since four is less than eight.

Now consider the following matrix (Luce & Raiffa, 1957, p. 282) of payoffs:

	S_1	S_2	S_3
A_1	10	5	1
A_2	0	10	4
A_3	5	2	10

This matrix leads to the following regret matrices when pairs of choices are considered:

	S_1	S_2	S_3
A_1	0	5	3
A_2	10	0	0

A_2	5	0	6
A_3	0	8	0
A_1	0	0	9
A_3	5	3	0

Savage's procedure yields the circularity:

i) A_1 picked over A_2 since A_1 has a maximum risk of 5 (in S_2) while A_2 has maximum risk of 10 (in S_1).

ii) A_2 picked over A_3 since A_2 has maximum risk of 6 (in S_3) while A_3 has maximum risk of 8 (in S_2).

iii) A_3 picked over A_1 since A_3 has maximum risk of 5 (in S_1) while A_1 has maximum risk of 9 (in S_3).

Formally this intransitivity is similar to the condition in May's model in which choices are made on the basis of high-to-low differences only. The primary distinction between the two models is with respect to the different empirical situations to which they would be relevant. In the May explanation, the choice occurs under certainty (i.e., the individual is aware of the results of his decision with probability one), and circular responses result from the multi-dimensionality of the stimuli. In Savage's discussion dimensionality of the stimuli is ignored, and possible intransitivity is a result of the differential effects of the possible states of nature.

Quandt (1956) develops a model of choice intended to apply particularly to consumer behavior. He argues that each commodity may be regarded as a collection of "primitive characteristics," such as size, weight, color, etc. and that a complete ordering exists among these primitive characteristics. Not

all the primitive characteristics are equally important in making a particular choice. Quandt even suggests that the characteristics of the same commodity may be weighted quite differently depending on external circumstances surrounding the choice situation, such as whether the individual is choosing alone or in the company of friends. When two commodities are compared, there is some probability that he will base his evaluation on the i^{th} characteristic of one and the j^{th} characteristic of the other. The probability of considering a particular characteristic of commodity A may or may not depend upon the particular B characteristic being considered. According to Quandt, when such a dependency does exist, intransitive choices may result. Consider a choice which must be made between, say, a coat and a pair of shoes. The Quandt model is concerned with measurements of, for example, the joint probability that the desirability of the shoes is judged on the basis of their color and the desirability of the coat is judged by the type of cloth.

Shepard (1964a) has presented a discussion of the effect of the "multi-attribute" nature of alternatives upon the choice process. In his opinion one source of the "subjective nonoptimality" of decisions (which includes the case of intransitivity) is an individual's inability to take account, simultaneously, of all the components of the alternatives. That is, although he may have no difficulty in judging the set of alternatives with respect to any particular attribute, Shepard feels he may experience difficulty in combining his evaluation of the separate attributes into a global judgment of the alternative. Consequently, there may be "...a consistent tendency for the subjects...(to rely)...too heavily on one or two of these factors while, in effect, ignoring the significant contributions of the remaining factors" [Shepard, 1964a, p. 265].

Shepard (1964b) describes a study in which this "attentional phenomenon" seems to have been present. The stimuli in this research were a number of circles with a radial line, or spoke, drawn in on each circle. These stimuli varied on two physical dimensions--the size of the circle and the angle of the spoke. Subjects were asked to select which of the set of stimuli was most similar to a standard stimulus. Shepard found that a number of subjects displayed a tendency to match either the size or the inclination of the standard, thus making judgments on the basis of whichever dimension was momentarily salient. It seemed that subjects were "...capable of switching between orderings of the alternatives in which one of the two dimensions completely dominates the other" [Shepard, 1964a, p. 273].

The "switching" which Shepard describes may result in choices which resemble a lexicographic semiorder. A lexicographic ordering is one in which stimuli are ordered on the basis of ratings on the first component or dimension. If two stimuli have the same rating on this first dimension, then the "tie" is broken by the ordering on the second dimension, and so on (a typical example would be the alphabetic ordering in a dictionary). Obviously there can be no intransitivities in a lexicographic order. A lexicographic semiorder occurs when, due to imperfect discriminative ability, the subject's rating of "equality" of two stimuli on the first dimension is not transitive (as with Luce's cups of coffee in Section 1.2). Thus, in making a judgment between pairs of stimuli A-B and B-C, the subject may in each case perceive equal ratings on the first dimension and so make his decision on the basis of ratings on the second dimension. However, for the pair A-C, the subject does not perceive such equality and so decides on the basis of ratings on the first dimension. It is evident that such a decision process may produce a circularity. For Shepard's stimuli perhaps subjects are using, say, the size dimension of the circles to

make a judgment until the difference in size becomes relatively small causing a switch to the "angle" dimension as a basis for judgment.

2.5 Formalization of Multidimensional Models

One of the first attempts to formalize the effect of multidimensional choice alternatives on transitivity was made by Morrison in his doctoral dissertation (1962). He began by assuming that each stimulus could be represented as a series of component values on the first through the n^{th} dimensions. Thus stimulus $X = (x_1, x_2, \ldots, x_n)$ where each x_i stands for the magnitude of X on the i^{th} attribute. Morrison then postulates the existence of a decision function, $D(X,Y)$, such that X is chosen over Y if $D(X,Y)$ is greater than zero. Consequently, a circular triad will result if $D(X,Y)$, $D(Y,Z)$, and $D(Z,X)$ are all greater than or all less than zero. It is assumed that a subject first estimates the difference between x_i and y_i for each dimension, then weights each of these difference estimates according to the perceived importance of the i^{th} dimension, and finally combines the weighted differences in some way to reach a decision.

From these assumptions Morrison indicates that intransitivities will not be predicted unless "...the difference function is a particular type of nonlinear function" [p. 16]. While not elaborating on the characteristics of this "particular type" he suggests the equation

$$d(x,y) = \gamma(x/y)^{\alpha}$$

from previous psychophysical research involving magnitude estimates of differences between stimuli (see Morrison, 1962, p. 16-17 for details). While the empirical work Morrison describes is rather inconclusive, his assumptions concerning estimation of component differences have led to some interesting refinements.

Such refinements have been predicated upon assumptions, which were first articulated by Krantz (1967) and Tversky and Krantz (1969a) for the case of

general multidimensional measurement. Their development is concerned with empirical judgments of dissimilarity or "psychological distance" by the subject. In such a case the basic equation of the model derived is $d(x,y) = F[\sum_i^n \phi_i(|X_i-Y_i|)]$, where $d(x,y)$ is a measure of such a distance. By appropriate specification of the ϕ_i and F, it is seen that the power metric or Minkowski r-metric, $d(x,y) = [\sum_i^n |X_i-Y_i|^r]^{1/r}$, is a special case of this model. The well-known Euclidean and city block metrics are obtained as still stronger cases, when r = 2 or 1, respectively.

Tversky (1969) discusses a model for choice behavior based on an application of the same assumptions which underlie the above distance model. In the choice situation, they may be stated as follows:

i) Decomposability: Let $X_1,\ldots,X_n$ be non-empty sets, with $\succsim$ a binary relation (preference in this case) on $X = \prod_{i=1}^n X_i$. Let f be a real-valued function of n real variables. Then $(X_1,\ldots,X_n,\succsim)$ is decomposable relative to f if there exist real valued functions ϕ, $\phi_1,\ldots,\phi_n$ defined on $X,X_1,\ldots,X_n$ respectively such that for $x = (x_1,\ldots,x_n)$, $y = (y_1,\ldots,y_n) \in X$, $x \succsim y$ if and only if $f[\phi_1(x_1,y_1),\ldots, \phi_n(x_n,y_n)] \geq 0$.

Assuming that $x = (x_1,\ldots,x_n)$ and $y = (y_1,\ldots,y_n)$ are stimuli characterized in terms of their components, the decomposability assumption implies that the choice between two stimuli is a function of the component-wise (i.e., dimensional) contributions. The function f gives the rule of combination for the contributions from each dimension, while $\phi_1,\ldots,\phi_n$ specify the appropriate measurement scales.

ii) Interdimensional additivity:
$x \succsim y$ if and only if $\sum_i^n f[\phi_i(x_i,y_i)] \geq 0$.

That is, the choice depends on the sum of component-wise contributions across the different dimensions.

iii) Intradimensional subtractivity:

$$x \succ y \text{ if and only if } \sum_i^n f_i[\phi_i(x_i) - \phi_i(y_i)] \geq 0 \quad .$$

Here the contribution of any single dimension is some function of the difference of scale values for each stimulus on that dimension. Thus, according to this, the additive difference model (ADM), choice behavior is described in terms of two independent processes, one satisfying intradimensional subtractivity and the other satisfying interdimensional additivity. These can be seen to be the formal equivalents of Morrison's assumptions described previously, in which the subject first estimates the difference between x_i and y_i on each dimension (estimates $\phi_i(x_i) - \phi_i(y_i)$), weights each of these difference estimates according to the perceived importance of the i^{th} dimension (applies f_i), and finally combines the weighted differences (takes $\sum_i^n$).

Now, consider the special case of the ADM in which all the difference functions are linear, i.e., in which $f_i(\delta_i) = t_i\delta_i$ for all i, where δ_i corresponds to the difference between the subjective values of x and y on the i^{th} dimension, $\phi_i(x_i) - \phi_i(y_i)$, and t_i is some positive constant. In this instance,

$$\sum_i^n f_i[\phi_i(x_i) - \phi_i(y_i)] = \sum_i^n t_i[\phi_i(x_i) - \phi_i(y_i)]$$
$$= \sum_i^n t_i\phi_i(x_i) - \sum_i^n t_i\phi_i(y_i)$$

Letting $v_i(x_i) = t_i\phi_i(x_i)$, then

$$\sum_i^n f_i[\phi_i(x_i) - \phi_i(y_i)] = \sum_i^n v_i(x_i) - \sum_i^n v_i(y_i) \quad .$$

But since alternative x is preferred to alternative y when the left hand side of the above expression is greater than or equal to zero, then x must be preferred to y if and only if

$$\phi(x) = \sum_{i}^{n} v_i(x_i) \geq \sum_{i}^{n} v_i(y_i) = \phi(y) \quad .$$

Tversky terms this special case of the ADM just the additive model. Such an additive structure has been the subject of detailed discussion by a number of other writers (for example, Adams & Fagot, 1959; Krantz, 1964; Luce & Tukey, 1964; Tversky, 1967b).

Although the additive model is formally equivalent to the ADM with the further restriction that the difference functions are linear, the two models have very different psychological implications concerning the way in which information about the alternatives is processed in order to reach a decision. The additive model implies a process of independent evaluation of each stimulus. A subject evaluates alternatives x and y separately, assigns $\phi(x)$ and $\phi(y)$ to the respective alternatives, and then makes the choice of x over y if and only if $\phi(x) > \phi(y)$. In contrast the ADM does not imply such a distinct evaluation but rather a consideration of the δ_i's, the pairwise differences of scale values on each dimension; each such δ_i makes some contribution to the overall judgment. Accordingly, Tversky suggests that this contribution, the $f_i(\delta_i)$ in each case, be viewed as the "advantage" or "disadvantage" of x over y (depending on whether δ_i is positive or negative) with respect to the i^{th} dimension. The δ_i values are then summed over all n dimensions, and x is chosen over y if this sum is greater than zero.

These two methods of processing alternatives were first distinguished by Morrison (1962) and elaborated on by Shepard (1964a) and Tversky (1969).

Schematically the difference may be viewed as follows:

$$x = (x_1, x_2, \ldots\ldots, x_i, \ldots\ldots, x_n) \Longrightarrow \sum_i^n \phi_i(x_i)$$

$$y = (y_1, y_2, \ldots\ldots, y_i, \ldots\ldots, y_n) \Longrightarrow \sum_i^n \phi_i(y_i)$$

$$\sum_i^n f_i[\phi_i(x_1) - \phi_i(y_1), \ldots, \phi_i(x_i) - \phi_i(y_i), \ldots, \phi_n(x_n) - \phi_n(y_n)] \quad .$$

The additive model leads to what has been termed "horizontal" processing in which scale values of the components are summed for each stimulus ($\Longrightarrow$) and the resulting totals compared to arrive at a choice. The ADM suggests "vertical" processing in which intradimensional differences are calculated ($\Downarrow$) and then summed to determine the choice. Since the additive model and the ADM are synonymous when all the difference functions are linear, the vertical and horizontal strategies may yield identical results, though implying different ways of processing the stimuli.

The relationship of the ADM to the problem of transitivity was investigated by Tversky who proved the following theorem (see 1969, appendix, for details of the proof):

If the additive difference model is satisfied, then the following assertions hold whenever the difference functions are defined.

1. For $n \geq 3$, transitivity holds if and only if all difference functions are linear. That is, $f_i(\delta) = t_i\delta$ for some positive t_i and all i.
2. For $n = 2$, transitivity holds if and only if $f_1(\delta) = f_2(t\delta)$ for some positive t.
3. For $n = 1$, transitivity is always satisfied.

Thus, for transitivity to be satisfied by the ADM, the difference function must take a certain form. For $n = 2$ (i.e., in the two dimensional case) the

difference function for each dimension must be the same except for a change of unit. If there are three or more dimensions, the theorem states that linear difference functions for each dimension is a necessary and sufficient condition for transitivity to hold. Since it has already been shown that when all difference functions are linear, the ADM reduces to the special case of the additive model, it is this case, and only this one, in which transitivity will be satisfied. That is, if any difference function is nonlinear, the transitivity assumption will be violated somewhere in the system.

Now, reconsidering the lexicographic semiorder in the context of the ADM, it is evident that the former is just a situation in which one of the difference functions is a step function. Tversky (1969) discusses a schematic illustration in which three alternatives are scaled on two dimensions as follows:

		Dimensions	
		I	II
	x	2ε	6ε
alternatives	y	3ε	4ε
	z	4ε	2ε

The alternatives might be job offers rated on dimensions of pay and rank as in an example discussed by Davidson, McKinsey and Suppes (1955), or, as Tversky suggests, the alternatives might be individuals applying for a job, rated on their intelligence and experience. In either case, suppose that a subject decides among a pair of alternatives by selecting the one with the higher value on the first dimension, providing that the difference between the members of the pair on this dimension is greater than ε. If this difference is less than or equal to ε, he selects the alternative which is scaled higher on the second

dimension. This, of course, is equivalent to the step function ($f_1(\delta) = 0$ when $\delta \leq \varepsilon$) and results in the following circular set of choices: x preferred to y, y preferred to z , and z preferred to x . A decision rule of this type is particularly appealing whenever the relevant dimension is noisy due to imperfect discrimination or to unreliability of measurements.

In the empirical investigation of this model, Tversky presented subjects with pairs of hypothetical applicants to a college. Each applicant was characterized by a graphic profile displaying percentile ranks on dimensions I (intellectual ability), E (emotional stability) and S (social facility). Subjects were requested to select the preferred applicant from each pair. They were instructed that "...intellectual ability would be the most important factor in your decision, but the other factors are of some value too. Also, you should bear in mind that the scores are based on the (selection) committee's ranking and so they may not be perfectly reliable" [1969, p. 37]. All 36 subjects participated in a preliminary session in which they made choices from a complete paired comparison schedule constructed from ten stimuli (applicant profiles). These stimuli were so chosen that a perfect negative correlation existed between scores on dimension I and scores on dimensions E and S. The results of this preliminary session were used to identify those subjects whose choice patterns came close to the lexicographic semiorder, i.e., choices made on the basis of dimension I until the I difference fell below some (epsilon) threshold. In this way 15 subjects were selected and invited to a test session. Each one was presented with a new set of profiles constructed so that the intermediate differences on the I dimension equaled the epsilon threshold estimated from the preliminary testing. Predictions derived from the ADM fit

the data significantly better than those expected from weak stochastic transitivity assumptions.

2.6 Other Empirical Research

Luce and Suppes (1965, pp. 380-390) present a review of empirical investigations of intransitivity. The great majority of this literature is not relevant to the present study for two reasons. First of all many of these studies are concerned with choice under uncertainty--the subject knows that there is some probability, neither zero nor one, that he will actually receive the alternative he selects. The present investigation will consider only those cases in which the subject receives his choice (or is aware of the consequences of his choice) with probability one. Secondly, as Edwards (1961) has pointed out, these papers often

> ...report experiments in which transitivity seems quite likely to be true, find an acceptably low percentage of intransitivities, and, in effect, accept the hypotheses they set out to accept. ...It seems likely that conditions can be designed in which subjects choose intransitively most of the time (unpublished research so indicates); it is even possible that the direction of intransitive cycles can be controlled by experimental manipulation. If so, the question for experimenters to answer is not whether any form of transitivity holds, but rather under what circumstances do various assumptions about transitivity hold, and under what circumstances do they not [p. 483].

A study by Davis (1958) approached the transitivity problem from a distinctly different perspective. Davis began by pointing out that preliminary to any discussion of a possible systematic basis for circular triads, there must be evidence of their stability over testings: "In none of the studies (which Davis reviews) were the same triads presented to the same subjects on two different occasions. Therefore, the above evidence fails to demonstrate that stable circular triads exist" [Davis, p. 29].

Accordingly, Davis undertook two experiments in which the same paired comparison schedules were administered to the same group of subjects on two separate occasions. The first experiment utilized stimuli similar to the ones in May's study. Forty-seven undergraduate male students were asked to indicate their marriage preferences among all possible pairs of nine girls. Each girl was described by a verbal rating on three relevant dimensions. For example, A was plain, very charming, wealthy; B was pretty, average charm, wealthy, etc. In the second experiment paired comparison choices similar to the ones originally used in a series of investigations by Edwards (1953, 1954a, 1954b) were presented to 24 students. Fifteen pairs of bets, each with a zero expected value, but differing in amount of money bet and probability of winning were the stimuli. In neither case did Davis find significant evidence for the existence of stable circular triads.

2.7 Intransitivity Models and Stable Circular Triads

Like the Davis study the present research seeks to find evidence for the existence of circular triads which will be repeated identically by a subject on two administrations of the same set of paired comparisons. Consequently, it is of interest to review the models discussed in this chapter specifically with respect to such consistent transitivities. The following chart indicates the prediction of each of the models listed at the left:

Model	Prediction
Luce--Choice Axiom	Symmetric Intransitive Triads--there will be as many circularities repeated in the opposite as in the original direction.

Model	Prediction
Coombs--Unfolding Theory	No consistent circularities since this would be a violation of weak stochastic transitivity.
May, Morrison, Tversky--Additive Difference Model	Consistent circularities expected.
Savage--Minimax	Not applicable to the present situation; only to choice under uncertainty.
Quandt--Consumer Behavior	Prediction unclear
Shepard--Attentional Model	Prediction unclear--if it can be assumed that the individual's attention will be focused on the same dimension during each testing, consistent circularities would be expected.

Morrison and Tversky are subsumed under May since they are more formal statements of the same model. It is only this model which has a definite expectation of consistent circularities.

CHAPTER III

DATA COLLECTION

3.1 Aims of the Present Study

This investigation presents a group of subjects the same paired comparison tasks on two separate occasions. However, both the choice of stimuli used in the schedules and the method of analysis were designed to overcome certain methodological weaknesses in the Davis study. The principal concerns of this study are as follows:

1) Can evidence be found for the existence of stable (i.e., over testings) circularities?

2) If such evidence is found, this work will investigate the appropriateness of the ADM discussed previously as a fit to these circularities.

3) If such evidence is not found, then the appropriateness of the "intransitivity as inconsistency" viewpoint will be investigated by exploring the relationship between circular triads and changes in response to individual items between the first and second testings. As a part of this concern, the Luce prediction of symmetric intransitive triads will be checked.

Five paired comparisons schedules were utilized. Each such schedule was administered twice to the same group of subjects.

3.2 The Stimuli

The first paired comparison schedule, the General Goals of Life Questionnaire (Appendix II), was developed by the Cooperative Study of General Education. It was selected both because in a previous study (Gulliksen, 1964) subjects had generated a large number of circular triads in responding to it, and

because it has been factor analyzed (Tucker, 1956; Gulliksen, 1964) presenting some knowledge of the underlying multidimensional space in which these items may be conceptualized by subjects. Each item in this questionnaire presents the subject with a pair of possible goals of life, and he is requested to choose the one he feels is more desirable. The 12 different statements of goals yield a paired comparison task with 66 choice pairs.

The second set of stimuli, the Payments Questionnaire (Appendix III) was constructed specifically for this study. It consists of sets of possible payments for participation in psychological research. Each payment consists of remuneration of three types: money (5, 10, or 15 dollars); grade points to be added to the subject's semester average (three, six, or nine points); and the opportunity to waive some required written reports (one, two, or three reports). Each item lists a pair of sets of such payments for the experimental participation, and the subject is requested to choose the preferred set.

This questionnaire was designed to overcome a possible weakness in the Davis study. The selection of hypothetical marriage partners as stimuli and the accompanying description implicitly assume that individual preference will increase with higher ratings on the three dimensions in the description--looks, charm and financial background. Actually many young men might well prefer a girl with a lower rating on one of these attributes, especially the one concerned with financial background. It is certainly a more defensible assumption that increases in ratings on the stimulus attributes presented here--money, grade points, and waived reports--will correspond to increased preference on the part of the subjects.

Since the three different types of remuneration have three degrees or amounts each, there are 27 possible stimuli that may be constructed. A complete

paired comparison schedule of these stimuli would involve 27(26)/2 or 351 judgments by each subject. Some practice testing with this number of stimuli proved to be too demanding on subjects, who generally agreed that after 70 or 80 such items, concentration became exceedingly difficult. Consequently, in order to reduce the amount of subject labor necessary and thereby ensure greater concentration, 12 stimuli were selected from the 27, and a paired comparison task of 66 items constructed from these 12.

A further reason for the design of the Payments Questionnaire concerns the difference between choices in situations in which the dimensionality of the underlying judgment space is inferred through some multivariate procedure such as factor analysis, and those in which the relevant dimensions are "built into" the description of the stimuli. Shepard points out that the former tend "...to be reacted to as homogeneous, unanalyzable wholes...while the latter stimuli tend to be analyzed in terms of dimensions which are...perceptually obvious and separable" [1964b, p. 59]. Of the five paired comparison schedules used in this study, only the Payments Questionnaire uses stimuli with such "built in" attributes. The difference between responses to the two distinct kinds of stimuli has been the subject of some discussion (Attneave, 1950; Torgerson, 1958, 1965; Shepard, 1964b). As Torgerson states in Theory and Methods of Scaling:

> ...if a subject is required to rate a set of stimulus pairs with respect to their similarity and the stimuli differ with respect to obvious and compelling dimensions, his ratings might very well behave as though they were a straight sum of the differences on the separate dimensions. ...On the other hand, if separate dimensions are not obvious, the subject might be more likely to judge the overall difference directly [1958, p. 254].

While these remarks refer to similarity judgments, the same considerations would be relevant to choice behavior.

The Occupations Questionnaire (Appendix IV) presents the subject with pairs of occupations. In each case the subject is asked to select the occupation which is "most looked up to." The 15 different occupations yield a paired comparison task with 105 choices to be made. This questionnaire was put together by selecting 15 of the 31 stimuli used in an earlier occupations questionnaire which utilized a multiple rank orders design. Factor analytic results are available on this 31 stimuli questionnaire (Gulliksen, 1964).

The Offenses Questionnaire (Appendix V) used in this study is an adaptation of a questionnaire designed by Thurstone (1927b). Of the 19 stimuli in the Thurstone work, eight were selected to produce a paired comparison task with 28 items. Each item presents the subject with a pair of criminal offenses, and he must choose which of the pair would cause him the greater shame.

Finally, the Vietnam Questionnaire (Appendix VI) was put together utilizing some statements from previous research on attitudes towards Vietnam (Pargament, 1968), some from Thurstone's scale of Attitudes towards War (Peterson, 1931), and some written specifically for this questionnaire. The statements are presented to the subject in pairs, and the subject is asked to choose which of the pair better represents his own opinion. There are 15 statements producing a paired comparison task with 105 items. The first four questionnaires all concern choices about topics on which subjects are very unlikely to have well rehearsed positions. This questionnaire was constructed to see if choices on an issue of current concern to--it is safe to assume--all subjects will produce a greater number of intransitivities.

3.3 Subjects

The subjects for the Goals of Life Questionnaire were 74 undergraduate students from two courses (introductory psychology and social psychology) at Bates College, Lewiston, Maine. Subjects for the Payments, Occupations and Offenses Questionnaires were 45 undergraduate students from Rutgers University College, Camden, New Jersey. The grading system there is the one, two, three, four, five type, corresponding to 90-100, 80-89, 70-79, 60-69 and below 60, respectively. Thus the three, six, or nine grade points as a part of their payment in the Payments Questionnaire would be relevant to them. Subjects for the Vietnam Questionnaire were 20 more undergraduate students from Rutgers University College at Camden.

3.4 Procedure

Each subject completed the assigned paired comparison task(s) during a regular class period. One week later the study was repeated with the same students and the same stimuli. On both occasions the subjects were requested to put their student ID number, or license number, etc. on the top of the instruction page of each questionnaire for identification purposes (i.e., in order to match the questionnaires from separate testings without identifying individuals with opinions). On all tasks subjects took considerable time and seemed to be making decisions carefully.

CHAPTER IV

DATA ANALYSIS

The data in the Davis study, collected by the same method utilized here, were presented in a 2 x 2 table in which the row classification was the frequency of circular and transitive triads during the first presentation, while the column classification was the same frequency count for the second presentation of the stimuli. Thus the four cells represented triads which were circular both times, triads which were transitive both times, triads which were circular the first time and transitive the second, and triads which were transitive the first time and circular the second.

The present study makes a more detailed analysis of subjects' responses than was possible in Davis's precomputer investigation. There are eight possible configurations of responses to each possible triad. For stimuli I, J, and K (and using > to stand for "is chosen over"), these would be as follows:

1. K > J, J > I, K > I
2. J > K, J > I, K > I
3. J > I, J > K, I > K
4. K > I, I > J, K > J
5. I > K, K > J, I > J
6. I > J, J > K, I > K
7. J > I, I > K, K > J
8. I > J, K > I, J > K

The first six possibilities are transitive, while the 7th and 8th are circular triads.

4.1 Stable Circularities

A computer program was written which creates an 8 x 8 matrix for every subject. The row subscript in each matrix corresponds to the configuration (of the eight listed above) used by the subject for a given triad on the first testing, while the column subscript corresponds to the configuration for the same triad on the second testing. Thus each of the 64 cells contains a frequency count--the number of triads that were chosen as designated by the row and column. This analysis was performed over all possible triads for each questionnaire. Since there are $n(n - 1)(n - 2)/6$ possible triads formed from n original stimuli, the total number of triads investigated for each questionnaire (i.e., the sum of the frequencies in the 64 cells) is as follows:

Questionnaire	No. of Stimuli	No. of Triads
Goals of Life	12	220
Payments	12	220
Occupations	15	455
Offenses	8	56
Vietnam	15	455

The diagonal cells naturally contain the frequencies of triads to which the subject responded exactly the same on both testings. Since the 7th and 8th rows and columns represent the two circular configurations, stable intransitivities would be indicated by sizable entries in the (7,7) and (8,8) cells of these matrices.

With one exception (to be discussed later) no such sizable entries in the 7th and 8th diagonal cells were found. Tables 1a, 1b, 1c, 1d and 1e present the matrices of totals (over subjects) for the Goals of Life, Occupations,

Offenses, Vietnam and Payments Questionnaires, respectively. Table 1a shows that there was a total of 41 (13 + 28) stable intransitivities for the Goals of Life Questionnaire, but this total is due to the responses of a number of subjects, no single one of whom produced more than six such stable circularities. Tables 1b, 1c and 1d show that similar totals over subjects were 4 (3 + 1) for the Occupations Questionnaire, 3 (2 + 1) for the Offenses Questionnaire and 7 (4 + 3) for the Vietnam Questionnaire.

As shown in Table 1e, there were 67 (39 + 28) stable circular triads produced by subjects on the Payments Questionnaire. However, 53 of these came from subject number 42, whose matrix of responses is presented in Table 2. It is interesting that this subject has no frequencies whatsoever in the off-diagonal cells, indicating that his choices were exactly the same on both testings. Disregarding the responses from this subject leaves a total of only 14 stable circular triads produced by the other subjects. Thus, with the exception of a single subject on the Payments Questionnaire, none of the stimuli used in this study have presented evidence of stable intransitivities.

4.2 The Luce Prediction

The Luce model implies that there will be symmetric intransitive triads. That is, there should be equal frequencies of triads which are circular in the same direction over the two testings and triads which are circular in opposite directions over the testings. Thus the specific prediction of the Luce model for the data presented here is that the sum of the (7,8) and (8,7) cells should be equal to the sum of the (7,7) and (8,8) cells.

Table 3 presents the results for each questionnaire of chi square tests of this prediction. These are one-tailed tests; the alternative to the null

Table 1a

Matrix of Totals for Goals of Life Questionnaire

	1	2	3	4	5	6	7	8
1	3186	692	92	415	63	26	59	50
2	604	2320	353	63	29	67	33	40
3	59	359	1079	21	42	284	38	27
4	503	68	35	1189	343	44	34	47
5	80	23	41	242	1258	231	29	22
6	27	63	254	32	225	993	12	33
7	58	40	26	20	34	30	13	10
8	25	40	28	33	21	26	9	28

Table 1b

Matrix of Totals for Occupations Questionnaire

	1	2	3	4	5	6	7	8
1	2917	283	22	387	26	7	9	3
2	269	1817	289	32	13	17	3	5
3	18	238	2397	7	33	271	12	2
4	396	7	9	4224	332	26	7	12
5	29	10	26	493	2726	347	11	4
6	3	22	305	14	316	1904	5	4
7	21	11	14	25	22	8	3	1
8	4	9	9	12	12	13	1	1

Table 1c

Matrix of Totals for Offenses Questionnaire

	1	2	3	4	5	6	7	8
1	200	49	3	64	12	11	3	3
2	28	203	64	13	12	16	2	1
3	13	54	323	15	16	53	7	1
4	47	11	4	268	60	17	1	4
5	6	15	10	42	254	60	6	4
6	8	7	50	10	69	337	2	2
7	4	3	5	4	11	5	2	0
8	0	0	3	11	4	6	1	1

Table 1d

Matrix of Totals for Vietnam Questionnaire

	1	2	3	4	5	6	7	8
1	950	185	19	171	15	12	14	12
2	229	1392	280	11	6	25	8	12
3	24	230	928	12	22	180	16	5
4	182	13	12	804	152	24	11	12
5	20	6	12	140	946	214	12	8
6	11	25	173	30	246	1092	9	15
7	15	6	13	8	8	11	3	2
8	9	25	18	17	8	25	1	4

Table 1e

Matrix of Totals for Payments Questionnaire

	1	2	3	4	5	6	7	8
1	1656	250	26	232	35	5	30	14
2	202	1064	158	29	3	13	18	18
3	24	125	1148	7	12	81	15	10
4	224	29	4	1136	227	10	25	23
5	23	8	9	183	1499	83	17	13
6	7	19	83	9	98	671	10	8
7	25	20	21	25	30	9	39	7
8	12	18	14	18	13	24	4	28

Table 2

Triad Matrix for Subject #42 on Payments Questionnaire

	1	2	3	4	5	6	7	8
1	40	0	0	0	0	0	0	0
2	0	36	0	0	0	0	0	0
3	0	0	24	0	0	0	0	0
4	0	0	0	31	0	0	0	0
5	0	0	0	0	27	0	0	0
6	0	0	0	0	0	9	0	0
7	0	0	0	0	0	0	32	0
8	0	0	0	0	0	0	0	21

hypothesis of equivalence between the diagonal and nondiagonal pairs of cells is the hypothesis that there is a greater frequency of stable intransitivities. The test on the data from the Payments Questionnaire excludes subject 42 who conclusively yielded stable circularities. Only one of these tests is significant, while two are not significant and two have frequencies too small to submit to statistical test. However, all five show a greater frequency of repeated circular triads than reversed ones.

Table 3

Test of Luce's Symmetric Intransitive Triads Prediction

H_0: sum of the (7,7) and (8,8) cells is equal to the sum of the (7,8) and (8,7) cells vs.

H_1: sum of the (7,7) and (8,8) cells is greater than the sum of the (7,8) and (8,7) cells.

	Obs Freq		Ex Freq			
Questionnaire	DiagPr	OffdiagPr	DiagPr	OffdiagPr	Chi Sq	Sig
Goals of Life	41	19	30	30	8.07	.005
Payments	14*	11*	12.5	12.5	.36	n.s.
Occupations**	4	2				
Offenses**	3	1				
Vietnam	7	3	5	5	1.6	n.s.

*Excludes subject #42

**Frequencies not large enough for chi square test

4.3 Intransitivity and Inconsistency--the Factor Analysis

The lack of evidence for stable circularities leaves the still significant problem of accounting for a large number of circular responses by subjects. If the assumption that intransitivity is synonymous with inconsistency is to be tenable, then total circular triads is essentially the same as number of reversals, or mean separation for reversals, or some similar variable. That is, the inconsistency explanation for circular choices implies that essentially the same information is derived from a single administration and total circular triads, as from the inconsistencies over two administrations.

In order to investigate this, the kind of change which takes place in the actual paired comparison choices for each off-diagonal cell was considered. Such changes may be characterized both by number and type. By number is meant whether one, two or three changes take place in the responses to the three pairs which comprise the triad. For example, if a subject's response to a triad during the first testing is $I > J$, $J > K$, $I > K$, and during the second testing, it becomes $J > I$, $J > K$, $I > K$, one change (in the I-J comparison) has taken place. Two or three changes may occur similarly. By type is meant whether the change involves an adjacent or extreme pair of stimuli in the response to the triad on the first testing. In the example given above, I-K is a pairing of the extreme stimuli for this triad, while I-K and J-K are pairs of adjacent stimuli. It is a change in response to the extreme stimuli that produces circularity; a change of response to adjacent stimuli results in a new ordering, but one that remains transitive. Table 4 presents the changes which produce each of the off-diagonal cells.

Table 4

Number and Type of Stimulus Changes

	1	2	3	4	5	6	7	8
1	0	1AD	2AD	1AD	2AD	3	1EX	2EX
2	1AD	0	1AD	2AD	3	2AD	2EX	1EX
3	2AD	1AD	0	3	2AD	1AD	1EX	2EX
4	1AD	2AD	3	0	1AD	2AD	2EX	1EX
5	2AD	3	2AD	1AD	0	1AD	1EX	2EX
6	3	2AD	1AD	2AD	1AD	0	2EX	1EX
7	1EX	2EX	1EX	2EX	1EX	2EX	0	3
8	2EX	1EX	2EX	1EX	2EX	1EX	3	0

1, 2 or 3 denotes the number of changes
AD denotes adjacent stimuli
EX denotes extreme stimuli

Thus each subject could be given a score on each of the following variables:

DIAG - sum of the frequencies in the first six diagonal cells; this is the number of triads which are transitive in exactly the same way each time.

REPCIR - sum of the frequencies in the 7th and 8th diagonal cells; the repeated circularities.

CIR - sum of the frequencies in the two cells which are circular on each testing in a different direction.

AD1 - sum of the frequencies in the 12 1AD* cells; transitive triads with one change in individual items.

*See Table 4

AD2 - sum of the frequencies in the 12 2AD* cells; transitive triads with two changes in individual items.

3C - sum of the frequencies in the six (transitive) cells with three changes.

EX1 - sum of the frequencies in the 12 1EX* cells; triads which are transitive on one testing and circular on the other with one change in individual items.

EX2 - sum of the frequencies in the 12 2EX* cells; triads which are transitive on one testing and circular on the other with two changes in individual items.

Scores on the following variables for each subject were also added to the score set described above:

TCT1 - number of total circular triads on the first administration.

TCT2 - number of total circular triads on the second administration.

REV - number of reversals of individual items from the first to the second testing.

MDR1 - the mean difference in votes on the first testing between members of the pair on items which were reversed.

MDR2 - the mean difference in votes on the second testing between members of the pair on items which were reversed.

Thus, there are a total of 13 measures for each subject. However, a number of linear dependencies exist between these variables and consequently, some were dropped from the analysis. Specifically, TCT1, TCT2, REPCIR and CIR contain duplicated information, and the latter two variables were deleted. Also,

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*See Table 4

variable 3C was dropped due to very low frequencies in these six cells. Finally, variables EX1 and EX2 were collapsed into one measure, EX, the number of triads which were circular on one of the testings and transitive on the other. This was done since previously unpublished research (Tucker, 1969) shows no significant differences in the frequencies in these two groups of cells. The above changes resulted in nine variables for each subject on each of five questionnaires.

The correlation matrices for each of these five sets of variables were formed. Since DIAG is the only measure for which large values indicate greater transitivity-consistency (i.e., the other variables are all measures of intransitivity and/or inconsistency), scores on the other eight variables were given negative signs. Consequently, higher values on all variables are indicative of greater transitivity or consistency. The correlation matrices are presented in Tables 5a, 5b, 5c, 5d and 5e.

Table 5a

Correlation Matrix for Vietnam Data

	TCT1	TCT2	REV	MDR1	MDR2	DIAG	AD1	AD2	EX
TCT1	1.000	.372	.470	.434	.812	.493	.353	.479	.778
TCT2	.372	1.000	.796	.893	.401	.772	.615	.835	.857
REV	.470	.796	1.000	.807	.578	.996	.949	.932	.829
MDR1	.434	.893	.807	1.000	.568	.790	.647	.879	.840
MDR2	.812	.401	.578	.568	1.000	.582	.447	.692	.701
DIAG	.493	.772	.996	.790	.582	1.000	.963	.917	.827
AD1	.353	.615	.949	.647	.447	.963	1.000	.805	.666
AD2	.479	.835	.932	.879	.692	.917	.805	1.000	.844
EX	.778	.857	.829	.840	.701	.827	.666	.844	1.000

Table 5b

Correlation Matrix for Occupations Data

	TCT1	TCT2	REV	MDR1	MDR2	DIAG	AD1	AD2	EX
TCT1	1.000	.338	.829	.393	.635	.795	.675	.835	.945
TCT2	.338	1.000	.308	.185	.055	.335	.314	.127	.610
REV	.829	.308	1.000	.292	.763	.992	.946	.911	.814
MDR1	.393	.185	.292	1.000	.296	.245	.135	.421	.372
MDR2	.635	.055	.763	.296	1.000	.746	.691	.782	.558
DIAG	.795	.335	.992	.245	.746	1.000	.977	.859	.797
AD1	.675	.314	.946	.135	.691	.977	1.000	.746	.694
AD2	.835	.127	.911	.421	.782	.859	.746	1.000	.755
EX	.945	.610	.814	.372	.558	.797	.694	.755	1.000

Table 5c

Correlation Matrix for Offenses Data

	TCT1	TCT2	REV	MDR1	MDR2	DIAG	AD1	AD2	E
TCT1	1.000	.445	.479	.300	.630	.519	.126	.475	.9
TCT2	.445	1.000	.351	.308	.106	.425	.220	.256	.7
REV	.479	.351	1.000	.738	.724	.932	.319	.924	.5
MDR1	.300	.308	.738	1.000	.674	.783	.461	.733	.3
MDR2	.630	.106	.724	.674	1.000	.769	.403	.733	.5
DIAG	.519	.425	.932	.783	.769	1.000	.624	.823	.5
AD1	.126	.220	.319	.461	.403	.624	1.000	.144	.2
AD2	.475	.256	.924	.733	.733	.823	.144	1.000	.5
EX	.901	.752	.541	.399	.506	.599	.203	.502	1.0

Table 5d

Correlation Matrix for Goals of Life Data

	TCT1	TCT2	REV	MDR1	MDR2	DIAG	AD1	AD2	
TCT1	1.000	.510	.561	.185	.399	.547	.131	.414	.
TCT2	.510	1.000	.711	.616	.154	.652	.094	.629	.
REV	.561	.711	1.000	.688	.582	.975	.593	.930	.
MDR1	.185	.616	.688	1.000	.594	.682	.383	.755	.
MDR2	.399	.154	.582	.594	1.000	.592	.433	.651	.
DIAG	.547	.652	.975	.682	.592	1.000	.737	.871	.
AD1	.131	.094	.593	.383	.433	.737	1.000	.449	.
AD2	.414	.629	.930	.755	.651	.871	.449	1.000	.
EX	.791	.907	.796	.561	.356	.752	.192	.676	1.

Table 5e

Correlation Matrix for Payments Data

	TCT1	TCT2	REV	MDR1	MDR2	DIAG	AD1	AD2	EX
TCT1	1.000	.707	.620	.002	.219	.702	.476	.654	.703
TCT2	.707	1.000	.684	.236	.151	.715	.486	.710	.775
REV	.620	.684	1.000	.193	.333	.980	.934	.956	.891
MDR1	.002	.236	.193	1.000	.822	.173	.158	.169	.293
MDR2	.219	.151	.333	.822	1.000	.325	.318	.327	.409
DIAG	.702	.715	.980	.173	.325	1.000	.943	.921	.864
AD1	.476	.486	.934	.158	.318	.943	1.000	.816	.725
AD2	.654	.710	.956	.169	.327	.921	.816	1.000	.888
EX	.703	.775	.891	.293	.409	.864	.725	.888	1.000

Each correlation matrix was now factor analyzed, and a promax (oblique) rotation performed where applicable. For the data from two questionnaires, occupations and Vietnam, one significant factor was extracted. The factor loadings in these two cases are shown in Tables 6 and 7, respectively.

Table 6

Factor Loadings for the Vietnam Data

	I	Communality
TCT1	.585	.342
TCT2	.831	.691
REV	.964	.929
MDR1	.875	.766
MDR2	.672	.452
DIAG	.959	.920
AD1	.818	.669
AD2	.963	.927
EX	.934	.872

Table 7

Factor Loadings for the Occupations Data

	I	Communality
TCT1	.887	.787
TCT2	.341	.116
REV	.991	.982
MDR1	.346	.120
MDR2	.749	.561
DIAG	.971	.943
AD1	.872	.760
AD2	.906	.821
EX	.878	.771

If, in fact, the tendency to produce circular triads is closely related to inconsistency in choice behavior, then, in each case, sizable loadings would be expected from both the measures of consistency and transitivity. Inspection of Tables 6 and 7 show that this is the case. Those variables which are measures of consistency--AD1, AD2, REV and DIAG--all show loadings well above .80 for both sets of data, and the order AD1 < AD2 < REV and DIAG, as expected, is maintained for each analysis. The measures of transitivity--TCT1, TCT2 and EX--show moderate to large loadings; for each set of data two of these three measures are well above .80. Furthermore, the fact that MDR1 and MDR2 also have moderate size loadings imply that the tendency to be inconsistent in making choices is related to the tendency to reverse items with large differences between the number of votes for each member of the pair. In sum, these loadings indicate that assuming intransitivity to be basically synonymous with inconsistency is defensible for the stimuli in the Vietnam and Occupations Questionnaires.

Each of the other three sets of data yielded two significant factors. Tables 8a and 8b, 9a and 9b, and 10a and 10b present the factor loadings and correlations of the factors for the goals of life, offenses and payments data, respectively.

For the goals of life and the offenses data, the first factor obviously represents consistency over testings with large loadings on REV, DIAG, AD1 and AD2. Again the expected ordering of AD1 < AD2 < REV and DIAG was found. Also, sizable loadings on this factor from MDR1 and MDR2 again signify the relation stated above between consistency and the magnitude of the difference between votes on reversed items. However, in these two cases, large loadings on the

Table 8a

Factor Loadings for the Goals of Life Data

	I	II	Communality
TCT1	.339	.511	.488
TCT2	.400	.716	.822
REV	.891	.230	.970
MDR1	.701	.104	.555
MDR2	.688	-.118	.473
DIAG	.940	.117	.981
AD1	.728	-.358	.576
AD2	.853	.148	.834
EX	.493	.758	.997

Table 8b

Correlations Between Factors for the Goals of Life Data

	I	II
I	1.000	.202
II	.202	1.000

Table 9a

Factor Loadings for the Offenses Data

	I	II	Communality
TCT1	.315	.690	.731
TCT2	.157	.600	.461
REV	.890	.049	.872
MDR1	.821	-.067	.695
MDR2	.773	.069	.672
DIAG	.925	.087	.969
AD1	.441	-.035	.201
AD2	.838	.030	.763
EX	.307	.860	.966

Table 9b

Correlations Between Factors for the Offenses Data

	I	II
I	1.000	.251
II	.251	1.000

Table 10a

Factor Loadings for the Payments Data

	I	II	Communality
TCT1	.709	-.094	.511
TCT2	.725	-.011	.558
REV	.951	.001	.966
MDR1	-.034	.898	.846
MDR2	.118	.837	.817
DIAG	.967	-.024	.985
AD1	.809	.014	.705
AD2	.923	-.008	.907
EX	.866	.113	.868

Table 10b

Correlations Between Factors for the Payments Data

	I	II
I	1.000	.253
II	.253	1.000

variables measuring transitivity are not found. Instead, the second factor for both the goals of life and the offenses data is defined by the three transitivity measures--TCT1, TCT2 and EX. Thus, in these two instances, transitivity and consistency are represented by different (though slightly correlated) factors, and the assumption that intransitivity and inconsistency are synonymous is not tenable.

The factor analysis for the payments data presents a completely different situation. Here the first factor is similar to the single factors found for the Vietnam and occupations data in that all the measures of transitivity and consistency load highly on it, and consequently, the intransitivity-inconsistency assumption is justifiable. However, instead of finding the usual relation between this factor and MDR1 and MDR2, a separate factor is defined by these two variables.

Thus in three of the five cases studied the factor analysis of the questionnaires provides support for the hypothesis that circular choices can be equated with reversed responses. Moreover, in two of these three supporting cases a greater degree of transitivity-consistency was found to be related to small average differences between votes for the members of pairs that were reversed over the two testings.

CHAPTER V

DISCUSSION AND CONCLUSIONS

5.1 Discussion

Except for one subject on one questionnaire, this study has found no evidence for the existence of circularities which remain stable over different administrations of the same pair comparisons task to the same individuals. A closer inspection of the responses of the one subject who did produce stable intransitivities reveals that this subject was actually choosing for each item the member of the pair which presented the "higher" payment on the greater number of dimensions. In other words this individual ignored the size of the difference and responded on the basis of the number of dimensions on which one stimulus was preferable to the other. In terms of the additive difference model this corresponds to a step function on each dimension for any difference between the stimuli on that dimension. That is, in making his choice, the subject is sensitive only to the fact that a difference exists, and not how great the difference is.

Although this is the only instance the author can find of deliberate and systematic intransitive choice behavior, there are other reported choice processes which might lead to intransitivities. Tversky and Krantz (1969b) describe a study in which the stimuli were schematic faces composed of three features (i.e., dimensions) each of which could appear in one of two ways. Thus the overall shape of the face could be wide or long; the eyes were circles which could be empty or blacked in; and the mouth was either straight or smiling. The combination of these three binary features resulted in eight schematic faces. Subjects were presented with pairs of these faces and asked to rate the dissimilarity of each pair from one (least) to 20 (most). Tversky

and Krantz report that one subject merely "...counted the number of dimensions on which the faces were different, responding seven, 14 or 20 according to whether there were differences on one, two or three dimensions" [1969b, p. 126]. This is the kind of process which might lead to intransitive choices, if a different kind of judgment were requested and if there were more than two values on each dimension. The essential similarity in the choice mechanism of the Tversky and Krantz subject and the intransitive subject in this study is obvious. Another example occurs in the Shepard study described previously in which subjects had to make judgments about geometric stimuli characterized by the size of the circle and the angle of the spoke. The "switching" of attention from one dimension to another is again a choice process which could result in circularity.

The interesting point concerning the three examples cited above--the subject in this experiment, the subject in the Tversky and Krantz study, and the "switching" subjects in the Shepard work--is that they were all responding to stimuli with "obvious and compelling" dimensions, as opposed to stimuli in which the dimensionality depends on subjective evaluation. As Shepard (1964b) has pointed out, "...of course, instead of a simple dichotomy here, there may actually exist a graded series...but, in any case, the extreme types can readily be recognized" [p. 80]. The implication of these examples is undeniably that stimuli on the perceptually obvious extreme are far more likely to evoke intransitive choice behavior that is, in some sense, systematic.

The lack of stable circularities implies that neither May, Morrison or Tversky's model is applicable to the stimuli used in these questionnaires. However, none of the stimuli here are the type that would provide a fair test for the Tversky model--these data were collected prior to its publication.

Aside from the single case discussed above, systematic intransitivity can be ruled out for the remainder of the subjects in this research. Yet there are large numbers of intransitive triads. The Luce expectation of symmetry of direction among triads chosen intransitively on both occasions is statistically rejected on only one questionnaire. However, the fact that all questionnaires have greater numbers of stable than unstable circularities makes the Luce prediction somewhat unconvincing.

It is very difficult to assess the applicability of Shepard's model. It would be necessary to ascertain not only the individual's subjective dimensions and his ordering of the alternatives with respect to each dimension, but also the conditions under which attention would be focused on one dimension rather than another.

The explanation of intransitivity as essentially synonymous with inconsistency was investigated by means of the factor analysis. Nine variables were computed for each subject; seven of these were measures of consistency or transitivity, while two--MDR1 and MDR2--may be considered measures of discrimination among stimuli on the part of the subjects.

For two of the questionnaires, Vietnam and occupations, this explanation was found to be justified. Loadings on the single factor obtained in each case tended to identify intransitivity with inconsistency. This would suggest that for these questionnaires similar information is derived from the total circular triads in one administration as knowledge about the reversals in two testings.

For two other questionnaires, goals of life and offenses, distinct factors were identified for transitivity and consistency. The significant question

concerns the differences between the type of stimuli resulting in a single factor and the type resulting in two factors. At this point only speculation can be offered on this question. Considering the questionnaires used here, the most noticeable difference seems to lie in the saliency of the stimuli for college students. Both their opinions on Vietnam and their judgments of the ratings of occupations would seem to be topics to which students have probably given considerable thought, and thus have well-rehearsed positions. In contrast, their feelings about the proper goals of life and the severity of certain offenses figure to be areas about which they do not have such well-rehearsed positions. (The previous two statements are, of course, the author's speculation based upon extensive, though unsystematic, experiences with and observations of contemporary college students.) For these latter stimuli, there is a much greater probability that subjects might undergo a real change in their opinions between the two administrations of the same questionnaire. Consequently, reversals and circularities would not be related to as great a degree as for the former stimuli.

For the payments data, the intransitivity-inconsistency explanation again seemed to be upheld as the variables measuring transitivity and those measuring consistency loaded highly on the same factor. However, the payments data exhibited an unusual feature. For the other four sets of data, the measures of discrimination--MDR1 and MDR2--loaded in such a way that subjects with finer discrimination (i.e., smaller mean differences between votes on members of reversed pairs) tended to show greater consistency. The same variables on the payments data showed almost no loading on the transitivity-consistency factor. In other words there seemed to be no relationship between the fineness

of the subject's discrimination and the degree of consistency he displayed. In fact, the second factor in the payments data, defined solely by MDR1 and MDR2, derives from the fact that these two variables showed a high correlation with each other (.822 from Table 5e) and low correlations with all the other variables. Again the significant problem concerns why this occurred specifically on the payments questionnaire, the only stimuli with definitely stated dimensionality. At present no obvious rationale for this result can be offered.

The present investigation suggests that further research on intransitivity might explore a number of possibilities. In addition to the type of stimuli chosen, the method of display is another factor deserving attention. A comparison might be made between the type of decision process subjects are utilizing when the stimuli are presented in a graphic profile (as in the Tversky study on choices between college applicants) and when the stimuli are presented as a set of numerical values on the different dimensions. Also, subjects might be asked not just to select one of the two alternatives in each case, but to make a graded response indicating how much one alternative exceeds the other (in brightness, severity, preferableness, etc.). In any event, the clearest implication of the present work for future research is that the most interesting stimuli for the study of intransitivity seem to be those, like the payments questionnaire, whose dimensions tend to be obvious and separable.

5.2 Summary and Conclusions

Five paired comparisons questionnaires were administered on two separate occasions. In each case the subjects for the second administration were the

same individuals who had completed the particular questionnaire the first time, so that data could be obtained on the responses of the same subject to the same paired comparisons tasks on two distinct administrations. The principal concerns were the following:

1) To find evidence for the existence of stable (i.e., over testings) circular triads.
2) To investigate the appropriateness of the additive difference model if such stable circularities are found.
3) If such evidence is not found, to investigate the intransitivity-as-inconsistency explanation by exploring the relationship between circular triads and changes in response to individual items over administrations.

With the exception of one subject on one questionnaire, no such evidence for stable intransitivities was found.

Accordingly, interest was then focused upon the assumption that intransitive choice behavior is basically the same as inconsistent choice behavior. Specifically, this view holds that one administration of a questionnaire and total circular triads is no different than two administrations and the number of reversals. This assumption was investigated by a factor analysis of nine variables derived from the subjects' choices. These variables were measures of consistency, transitivity and discrimination among stimuli. Results of this analysis suggest that the assumption of circular choices as synonymous with inconsistency is upheld for three of the five questionnaires.

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APPENDIX I

Computation of Total Circular Triads

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Computation of Total Circular Triads

Consider the paired comparisons votes matrix. Both the rows and the column correspond to the individual stimuli. In each cell there is a "one" if the row stimulus was chosen over the column, or a "zero" if the column stimulus was chosen over the row.

Now, if a subject's paired comparison choices are all transitive--there is no triad configured intransitively--then the column totals of this matrix will be the integers from 0 to n - 1, where n is the total number of stimuli. Also, when all triads are transitive, the sum of squares of the column totals is a maximum. Every circularity in the paired comparison matrix will now decrease this sum of squares by 2. Consequently, the total circular triads for an individual is given by

$$TCT = 1/2 \left[\sum_{i=0}^{n=1} i^2 - \sum_{j=1}^{n} V_j^2 \right] ,$$

where n is the number of stimuli, and V_j is the total number of votes in the j^{th} column.

ED 062377

General Goals of Life Questionnaire

TM 001 311

General Goals of Life Questionnaire

This questionnaire consists of a number of statements, arranged in pairs, which express what some persons have considered the main goals of life. In each pair, you are to decide which statement you consider to be the more desirable goal of life. If both statements seem to you to mean exactly the same thing, choose the form of expression which is slightly preferable to you. If you dislike both statements, choose the less objectionable.

Make a choice between the statements in every pair. In choosing, interpret the meaning of each statement for yourself; do not worry over the fact that other people may give it different meanings.

The pairs of statements in this questionnaire are numbered from 1 to 66. In each pair choose the statement which is to you the more desirable expression of a goal of life; then put a plus (+) in the square beside the letter of the statement you have chosen.

Sample Answers

I M [+]
O [ ]

In item I, the person who marked this example preferred statement M to statement O.

II Z [ ]
T [+]

In item II, the person who marked this example preferred statement T to statement Z.

General Goals of Life Questionnaire

1. ☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.
   ☐ H Power; control over people and things.

2. ☐ E Serving the community of which I am a part.
   ☐ D Self sacrifice for the sake of a better world.

3. ☐ A Gaining personal immortality in heaven.
   ☐ G Making a place for myself in the world; getting ahead.

4. ☐ C Leading a moral life as dictated by God.
   ☐ J Finding my place in life and accepting it.

5. ☐ E Serving the community of which I am a part.
   ☐ I Doing the best I can for myself.

6. ☐ H Power; control over people and things.
   ☐ B Devotion to God, doing God's Will.

7. ☐ J Finding my place in life and accepting it.
   ☐ A Gaining personal immortality in heaven.

8. ☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.
   ☐ C Leading a moral life as dictated by God.

9. ☐ I Doing the best I can for myself.
   ☐ H Power; control over people and things.

10. ☐ G Making a place for myself in the world; getting ahead.
    ☐ J Finding my place in life and accepting it.

11. ☐ E Serving the community of which I am a part.
    ☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

12. ☐ D Self sacrifice for the sake of a better world.
☐ H Power; control over people and things.

13. ☐ L Handling the specific problems of life as they arise.
☐ B Devotion to God, doing God's Will.

14. ☐ I Doing the best I can for myself.
☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

15. ☐ F Promoting the most deep and lasting pleasures for others as I can.
☐ A Gaining personal immortality in heaven.

16. ☐ G Making a place for myself in the world; getting ahead.
☐ C Leading a moral life as dictated by God.

17. ☐ L Handling the specific problems of life as they arise.
☐ I Doing the best I can for myself.

18. ☐ F Promoting the most deep and lasting pleasures for others as I can.
☐ E Serving the community of which I am a part.

19. ☐ D Self sacrifice for the sake of a better world.
☐ B Devotion to God, doing God's Will.

20. ☐ H Power; control over people and things.
☐ L Handling the specific problems of life as they arise.

21. ☐ F Promoting the most deep and lasting pleasures for others as I can.
☐ G Making a place for myself in the world; getting ahead.

22. ☐ D Self sacrifice for the sake of a better world.
☐ J Finding my place in life and accepting it.

23. ☐ A Gaining personal immortality in heaven.
☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

24. ☐ B Devotion to God, doing God's Will.
☐ E Serving the community of which I am a part.

25. ☐ G Making a place for myself in the world; getting ahead.
☐ D Self sacrifice for the sake of a better world.

26. ☐ L Handling the specific problems of life as they arise.
☐ J Finding my place in life and accepting it.

27. ☐ H Power; control over people and things.
☐ A Gaining personal immortality in heaven.

28. ☐ I Doing the best I can for myself.
☐ D Self sacrifice for the sake of a better world.

29. ☐ C Leading a moral life as dictated by God.
☐ L Handling the specific problems of life as they arise.

30. ☐ F Promoting the most deep and lasting pleasures for others as I can.
☐ B Devotion to God, doing God's Will.

31. ☐ J Finding my place in life and accepting it.
☐ I Doing the best I can for myself.

32. ☐ G Making a place for myself in the world; getting ahead.
☐ L Handling the specific problems of life as they arise.

33. ☐ D Self sacrifice for the sake of a better world.
☐ A Gaining personal immortality in heaven.

34. ☐ F Promoting the most deep and lasting pleasures for others as I can.
☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

35. ☐ B Devotion to God, doing God's Will.
☐ G Making a place for myself in the world; getting ahead.

36. ☐ C Leading a moral life as dictated by God.

☐ H Power; control over people and things.

37. ☐ J Finding my place in life and accepting it.

☐ E Serving the community of which I am a part.

38. ☐ L Handling the specific problems of life as they arise.

☐ F Promoting the most deep and lasting pleasures for others as I can.

39. ☐ B Devotion to God, doing God's Will.

☐ I Doing the best I can for myself.

40. ☐ C Leading a moral life as dictated by God.

☐ D Self sacrifice for the sake of a better world.

41. ☐ J Finding my place in life and accepting it.

☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

42. ☐ E Serving the community of which I am a part.

☐ G Making a place for myself in the world; getting ahead.

43. ☐ D Self sacrifice for the sake of a better world.

☐ L Handling the specific problems of life as they arise.

44. ☐ B Devotion to God, doing God's Will.

☐ C Leading a moral life as dictated by God.

45. ☐ A Gaining personal immortality in heaven.

☐ E Serving the community of which I am a part.

46. ☐ D Self sacrifice for the sake of a better world.

☐ F Promoting the most deep and lasting pleasures for others as I can.

47. ☐ H Power; control over people and things.

☐ J Finding my place in life and accepting it.

48. ☐ L Handling the specific problems of life as they arise.

☐ E Serving the community of which I am a part.

49. ☐ C Leading a moral life as dictated by God.

☐ F Promoting the most deep and lasting pleasures for others as I can.

50. ☐ B Devotion to God, doing God's Will.

☐ A Gaining personal immortality in heaven.

51. ☐ H Power; control over people and things.

☐ E Serving the community of which I am a part.

52. ☐ J Finding my place in life and accepting it.

☐ F Promoting the most deep and lasting pleasures for others as I can.

53. ☐ I Doing the best I can for myself.

☐ C Leading a moral life as dictated by God.

54. ☐ G Making a place for myself in the world; getting ahead.

☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

55. ☐ A Gaining personal immortality in heaven.

☐ L Handling the specific problems of life as they arise.

56. ☐ C Leading a moral life as dictated by God.

☐ E Serving the community of which I am a part.

57. ☐ B Devotion to God, doing God's Will.

☐ J Finding my place in life and accepting it.

58. ☐ A Gaining personal immortality in heaven.

☐ I Doing the best I can for myself.

59. ☐ D Self sacrifice for the sake of a better world.

☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

60. ☐ G Making a place for myself in the world; getting ahead.

☐ H Power; control over people and things.

61. ☐ F Promoting the most deep and lasting pleasures for others as I can.

☐ I Doing the best I can for myself.

62. ☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

☐ B Devotion to God, doing God's Will.

63. ☐ C Leading a moral life as dictated by God.

☐ A Gaining personal immortality in heaven.

64. ☐ I Doing the best I can for myself.

☐ G Making a place for myself in the world; getting ahead.

65. ☐ K Being able to "take it", brave and uncomplaining acceptance of what circumstances bring.

☐ L Handling the specific problems of life as they arise.

66. ☐ F Promoting the most deep and lasting pleasures for others as I can.

☐ H Power; control over people and things.

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APPENDIX III

Payments Questionnaire

TM 001 312

Assume that one of the requirements of a one semester course in psychology which you are taking is to participate as a subject in ten hours of experimentation (five 2-hour sessions). Another requirement for this course is to write a 300 word paper every third week (5 papers in all). As remuneration for the experimental work, you may receive an amount of money plus a number of points added to your semester grade plus the opportunity to waive some of the written reports.

Consider the following pairs of sets of possible payment for the experiment participation. In each case you are to decide which payment set you would prefer and then make a check in the space to the left of that choice. Be sure to mark one payment set for every pair.

Sample Answer: ___√ 15$ 9 grade pts 3 less repts
___ 5$ 3 grade pts 1 less rept

In the sample the person preferred the top set as payment to the bottom.

1. ___15$ 6 grade pts 1 less rept
___10$ 9 grade pts 1 less rept

2. ___10$ 3 grade pts 1 less rept
___ 5$ 9 grade pts 3 less repts

3. ___ 5$ 6 grade pts 2 less repts
___10$ 6 grade pts 2 less repts

4. ___ 5$ 9 grade pts 1 less rept
___15$ 3 grade pts 2 less repts

5. ___10$ 3 grade pts 1 less rept
___15$ 3 grade pts 1 less rept

6. ___10$ 9 grade pts 1 less rept
___ 5$ 6 grade pts 3 less repts

7. ___15$ 3 grade pts 2 less repts
___ 5$ 6 grade pts 2 less repts

8. ___15$ 6 grade pts 1 less rept
___ 5$ 9 grade pts 1 less rept

9. ___15$ 3 grade pts 1 less rept
___10$ 9 grade pts 1 less rept

10. ___10$ 6 grade pts 2 less repts
___15$ 3 grade pts 2 less repts

11. ___10$ 3 grade pts 1 less rept
___15$ 6 grade pts 1 less rept

12. ___ 5$ 9 grade pts 3 less repts
___10$ 9 grade pts 1 less rept

13. ___15$ 6 grade pts 2 less repts
___ 5$ 6 grade pts 3 less repts

14. ___15$ 3 grade pts 1 less rept
___15$ 6 grade pts 1 less rept

15. ___10$ 3 grade pts 3 less repts
___ 5$ 6 grade pts 2 less repts

16. ___10$ 6 grade pts 2 less repts
___ 5$ 9 grade pts 1 less rept

17. ___15$ 6 grade pts 2 less repts
___15$ 3 grade pts 1 less rept

18. ___10$ 3 grade pts 3 less repts
___10$ 3 grade pts 1 less rept

19. ___ 5$ 9 grade pts 3 less repts
___ 5$ 6 grade pts 3 less repts

20. ___10$ 9 grade pts 1 less rept
___15$ 6 grade pts 2 less repts

21. ___10$ 3 grade pts 3 less repts
___10$ 6 grade pts 2 less repts

22. ___ 5$ 9 grade pts 3 less repts
___15$ 3 grade pts 2 less repts

23. ___ 5$ 6 grade pts 2 less repts
___15$ 6 grade pts 1 less rept

24. ___ 5$ 6 grade pts 3 less repts
___10$ 3 grade pts 1 less rept

25. ___10$ 6 grade pts 2 less repts
___ 5$ 9 grade pts 3 less repts

26. ___15$ 6 grade pts 2 less repts
___15$ 3 grade pts 2 less repts

27. ___10$ 9 grade pts 1 less rept
___ 5$ 6 grade pts 2 less repts

28. ___15$ 3 grade pts 1 less rept
___ 5$ 9 grade pts 3 less repts

29. ___ 5$ 9 grade pts 1 less rept
___15$ 6 grade pts 2 less repts

30. ___10$ 3 grade pts 3 less repts
___ 5$ 6 grade pts 3 less repts

31. ___15$ 3 grade pts 2 less repts
___15$ 3 grade pts 1 less rept

32. ___10$ 6 grade pts 2 less repts
___15$ 6 grade pts 2 less repts

33. ___ 5$ 9 grade pts 3 less repts
___ 5$ 6 grade pts 2 less repts

34. ___10$ 3 grade pts 3 less repts
___15$ 6 grade pts 1 less rept

35. ___ 5$ 6 grade pts 3 less repts
___10$ 6 grade pts 2 less repts

36. ___ 5$ 9 grade pts 1 less rept
___10$ 9 grade pts 1 less rept

37. ___15$ 3 grade pts 2 less repts
___10$ 3 grade pts 1 less rept

38. ___15$ 6 grade pts 2 less repts
___10$ 3 grade pts 3 less repts

39. ___ 5$ 6 grade pts 3 less repts
___15$ 3 grade pts 1 less rept

40. ___ 5$ 9 grade pts 1 less rept
___ 5$ 9 grade pts 3 less repts

41. ___15$ 3 grade pts 2 less repts
___15$ 6 grade pts 1 less rept

42. ___10$ 3 grade pts 1 less rept
___10$ 6 grade pts 2 less repts

43. ___ 5$ 9 grade pts 3 less repts
___15$ 6 grade pts 2 less repts

44. ___ 5$ 6 grade pts 3 less repts
___ 5$ 9 grade pts 1 less rept

45. ___ 5$ 6 grade pts 2 less repts
___10$ 3 grade pts 1 less rept

46. ___ 5$ 9 grade pts 3 less repts
___10$ 3 grade pts 3 less repts

47. ___10$ 9 grade pts 1 less rept
___15$ 3 grade pts 2 less repts

48. ___15$ 6 grade pts 2 less repts
___10$ 3 grade pts 1 less rept

49. ___ 5$ 9 grade pts 1 less rept
___10$ 3 grade pts 3 less repts

50. ___ 5$ 6 grade pts 3 less repts
___ 5$ 6 grade pts 2 less repts

51. ___10$ 9 grade pts 1 less rept
___10$ 3 grade pts 1 less rept

52. ___15$ 3 grade pts 2 less repts
___10$ 3 grade pts 3 less repts

53. ___15$ 3 grade pts 1 less rept
___ 5$ 9 grade pts 1 less rept

54. ___10$ 6 grade pts 2 less repts
___15$ 6 grade pts 1 less rept

55. ___ 5$ 6 grade pts 2 less repts
___15$ 6 grade pts 2 less repts

56. ___ 5$ 9 grade pts 1 less rept
___10$ 3 grade pts 1 less rept

57. ___ 5$ 6 grade pts 3 less repts
___15$ 3 grade pts 2 less repts

58. ___ 5$ 6 grade pts 2 less repts
___15$ 3 grade pts 1 less rept

59. ___ 5$ 9 grade pts 3 less repts
___15$ 6 grade pts 1 less rept

60. ___10$ 6 grade pts 2 less repts
___10$ 9 grade pts 1 less rept

61. ___10$ 3 grade pts 3 less repts
___15$ 3 grade pts 1 less rept

62. ___15$ 6 grade pts 1 less rept
___ 5$ 6 grade pts 3 less repts

63. ___ 5$ 9 grade pts 1 less rept
___ 5$ 6 grade pts 2 less repts

64. ___15$ 3 grade pts 1 less rept
___10$ 6 grade pts 2 less repts

65. ___15$ 6 grade pts 1 less rept
___15$ 6 grade pts 2 less repts

66. ___10$ 3 grade pts 3 less repts
___10$ 9 grade pts 1 less rept

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IV-2

OCCUPATIONS

In most communities certain occupations are accorded a higher rating than others. There is a tendency for us to look up to persons engaged in some occupations and down on those engaged in others. We may even be ashamed or proud of our relatives because of their occupations.

Consider the following pairs of occupations. In each case decide which of the pair you feel is most looked up to, and place a check in the space to the left of that occupation. Be sure to mark one occupation in each pair, even if it is a sheer guess.

1.	___Artist	___Author	29.	___Elem school teacher	___Mail carrier
2.	___University professor	___Businessman	30.	___Farmer	___Lawyer
3.	___Tailor	___Butcher	31	___Artist	___Butcher
4.	___Physician	___Carpenter	32	___Businessman	___Carpenter
5.	___Mail carrier	___Clergyman	33.	___Author	___Clergyman
6.	___Lawyer	___Coal miner	34.	___University professor	___Coal miner
7.	___Farmer	___Electrician	35.	___Tailor	___Electrician
8.	___Elem school teacher	___Artist	36.	___Physician	___Elem school teacher
9.	___Businessman	___Author	37.	___Mail carrier	___Farmer
10.	___Butcher	___University professor	38.	___Lawyer	___Artist
11.	___Carpenter	___Tailor	39.	___Carpenter	___Butcher
12.	___Clergyman	___Physician	40.	___Clergyman	___Businessman
13.	___Coal miner	___Mail carrier	41.	___Coal miner	___Author
14.	___Electrician	___Lawyer	42.	___Electrician	___University professor
15.	___Elem school teacher	___Farmer	43.	___Elem school teacher	___Tailor
16.	___Artist	___Businessman	44.	___Farmer	___Physician
17.	___Author	___Butcher	45.	___Lawyer	___Mail carrier
18.	___University professor	___Carpenter	46.	___Artist	___Carpenter
19.	___Tailor	___Clergyman	47.	___Butcher	___Clergyman
20.	___Physician	___Coal miner	48.	___Businessman	___Coal miner
21.	___Mail carrier	___Electrician	49.	___Author	___Electrician
22	___Lawyer	___Elem school teacher	50.	___University professor	___Elem school teacher
23.	___Farmer	___Artist	51.	___Tailor	___Farmer
24.	___Butcher	___Businessman	52.	___Physician	___Lawyer
25.	___Carpenter	___Author	53.	___Mail carrier	___Artist
26.	___Clergyman	___University professor	54.	___Clergyman	___Carpenter
27.	___Coal miner	___Tailor	55	___Coal miner	___Butcher
28.	___Electrician	___Physician	56	___Electrician	___Businessman

57. ___Elem school teacher ___Author
58. ___Farmer ___University professor
59. ___Lawyer ___Tailor
60. ___Mail carrier ___Physician
61. ___Artist ___Clergyman
62. ___Carpenter ___Coal miner
63. ___Butcher ___Electrician
64. ___Businessman ___Elem school teacher
65. ___Author ___Farmer
66. ___University professor ___Lawyer
67. ___Tailor ___Mail carrier
68. ___Physician ___Artist
69. ___Coal miner ___Clergyman
70. ___Electrician ___Carpenter
71. ___Elem school teacher ___Butcher
72. ___Farmer ___Businessman
73. ___Lawyer ___Author
74. ___Mail carrier ___University professor
75. ___Physician ___Tailor
76. ___Artist ___Coal miner
77. ___Clergyman ___Electrician
78. ___Carpenter ___Elem school teacher
79. ___Butcher ___Farmer
80. ___Businessman ___Lawyer
81. ___Author ___Mail carrier
82. ___University professor ___Physician
83. ___Tailor ___Artist
84. ___Electrician ___Coal miner
85. ___Elem school teacher ___Clergyman
86. ___Farmer ___Carpenter
87. ___Lawyer ___Butcher
88. ___Mail carrier ___Businessman
89. ___Physician ___Author
90. ___Tailor ___University professor
91. ___Artist ___Electrician
92. ___Coal miner ___Elem school teacher
93. ___Clergyman ___Farmer
94. ___Carpenter ___Lawyer
95. ___Butcher ___Mail carrier
96. ___Businessman ___Physician
97. ___Author ___Tailor
98. ___University professor ___Artist
99. ___Electrician ___Elem school teacher
100. ___Coal miner ___Farmer
101. ___Clergyman ___Lawyer
102. ___Carpenter ___Mail carrier
103. ___Butcher ___Physician
104. ___Businessman ___Tailor
105. ___Author ___University professor

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APPENDIX V

Offenses Questionnaire

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OFFENSES

Imagine that you were arrested for a given offense, that you were guilty of it, and the fact of your arrest was reported in your home town newspaper.

Consider the offenses two at a time. Which of the two under the above circumstances would cause you the greater shame? Place a check in the space to the left of that offense. Be sure to mark one offense in each pair, even if it is a sheer guess.

1.	___Blackmail	___Smuggling
2.	___Embezzlement	___Shoplifting
3.	___Drunk driving	___Smuggling
4.	___Adultery	___Shoplifting
5.	___Smuggling	___Bribing officials
6.	___Shoplifting	___Blackmail
7.	___Adultery	___Tax fraud
8.	___Tax fraud	___Drunk driving
9.	___Blackmail	___Bribing officials
10.	___Smuggling	___Adultery
11.	___Embezzlement	___Tax fraud
12.	___Bribing officials	___Shoplifting
13.	___Blackmail	___Embezzlement
14.	___Tax fraud	___Shoplifting
15.	___Bribing officials	___Tax fraud
16.	___Shoplifting	___Smuggling
17.	___Drunk driving	___Embezzlement
18.	___Tax fraud	___Blackmail
19.	___Embezzlement	___Adultery
20.	___Drunk driving	___Blackmail
21.	___Smuggling	___Embezzlement
22.	___Bribing officials	___Adultery
23.	___Shoplifting	___Drunk driving
24.	___Smuggling	___Tax fraud
25.	___Adultery	___Blackmail
26.	___Bribing officials	___Drunk driving
27.	___Embezzlement	___Bribing officials
28.	___Adultery	___Drunk driving

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APPENDIX VI

Vietnam Questionnaire

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Vietnam Questionnaire

The following pages contain a number of statements about the war in Vietnam, arranged in pairs. For each pair decide which pair better represents your own opinion on the war and place a check in the space to the left of that statement. Even if you disagree with both statements, choose the one which is less objectionable.

Make a choice between the statements in every pair. In choosing interpret the meaning of each statement for yourself; do not worry over the fact that other people may give it different meanings.

1.____ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.
____ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.

2.____ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.
____ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.

3.____ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.
____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.

4.____ Because right may be more important than peace, war may be the lesser of two evils.
____ The misery and suffering caused by the war in Vietnam are not worth its benefits.

5.____ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.
____ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.

6.____ The U.S. must negotiate from a clear position of military strength rather than weakness.
____ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.

7.____ The withdrawal of American troops that Hanoi stipulates as a prerequisitefor peace talks is simply a trick which will enable the Viet Cong to take over the country.
____ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.

8.____ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.
____ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.

9.____ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.
____ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.

10.____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.
____ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.

11.____ The misery and suffering caused by the war in Vietnam are not worth its benefits.
____ The security of the U.S. is very much related to the security of South Vietnam. A victory will mean greater security and further assurance of a lasting peace in the future.

12.____ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its peoples these rights.
____ Because right may be more important than peace, war may be the lesser of two evils.

13.____ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.
____ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.

14.____ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.
____ The U.S. must negotiate from a clear position of military strength rather than weakness.

15.____ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.
____ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick which will enable the Viet Cong to take over the country.

16.____ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.
____ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.

17.____ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.
____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.

18.____ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.
____ The misery and suffering caused by the war in Vietnam are not worth its benefits.

19.____ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.
____ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.

20.____ Because right may be more important than peace, war may be the lesser of two evils.
____ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.

21.___ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.

___ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.

22.___ The U.S. must negotiate from a clear position of military strength rather than weakness.

___ As the National Liberation Front already has support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.

23.___ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick that will enable the Viet Cong to take over the country.

___ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.

24.___ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.

___ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.

25.___ The misery and suffering caused by the war in Vietnam are not worth its benefits.

___ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.

26.___ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people that right.

___ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.

27.___ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.

___ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.

28.___ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.

___ Because right may be more important than peace, war may be the lesser of two evils.

29.___ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.

___ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.

30.___ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick which will enable the Viet Cong to take over the country.

___ The U.S. must negotiate from a clear position of military strength rather than weakness.

31.____ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.
____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.

32.____ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.
____ The misery and suffering caused by the war in Vietnam are not worth its benefits.

33.____ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.
____ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.

34.____ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.
____ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.

35.____ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.
____ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.

36.____ Because right may be more important than peace, war may be the lesser of two evils.
____ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.

37.____ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.
____ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick which will enable the Viet Cong to take over the country.

38.____ The U.S. must negotiate from a clear position of military strength rather than from weakness.
____ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.

39.____ The misery and suffering caused by the war in Vietnam are not worth its benefits.
____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam

40.____ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.
____ The Communists must be stopped now in Vietnam, rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.

41.____ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.
____ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.

42.____ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.
____ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.

43.____ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.
____ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.

44.____ The withdrawal of American troops that Hanoi stipulates as a prerequisite forpeace talks is simply a trick which will enable the Viet Cong to take over the country.
____ Because right may be more important than peace, war may be the lesser of two evils.

45.____ The U.S. must negotiate from a clear position of military strength rather than weakness.
____ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.

46.____ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.
____ The misery and suffering caused by the war in Vietnam are not worth its benefits.

47.____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.
____ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.

48.____ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.
____ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.

49.____ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.
____ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.

50.____ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.
____ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.

51.___ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.
___ The withdrawal of American troops that Hanoi stipulates as a prerequisite to peace talks is simply a trick which will enable the Viet Cong to take over the country.

52.___ Because right may be more important than peace, war may be the lesser of two evils.
___ The U.S. must negotiate from a clear position of military strength rather than weakness.

53.___ The U.S. certainly did not appreciate outside military intervention during their own revolution and should not intervene in the revolutions of other countries.
___ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.

54.___ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.
___ The misery and suffering caused by the war in Vietnam are not worth its benefits

55.___ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.
___ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.

56.___ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.
___ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.

57.___ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.
___ Even if someone feels that the war in Vietnam is not justified he should nevertheless serve at the front or wherever he is needed.

58.___ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick which will enable the Viet Cong to take over the country.
___ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.

59.___ The U.S. must negotiate from a clear position of military strength rather than weakness.
___ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.

60.___ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.
___ Because right may be more important than peace, war may be the lesser of two evils.

61.___ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.
___ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.

62.___ The misery and suffering caused by the Vietnam war are not worth its benefits.
___ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.

63.___ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.
___ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.

64.___ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.
___ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.

65.___ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.
___ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick that will enable the Viet Cong to take over the country.

66.___ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.
___ The U.S. must negotiate from a clear position of military strength rather than weakness.

67.___ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.
___ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.

68.___ Because right may be more important than peace, war may be the lesser of two evils.
___ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.

69.___ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.
___ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.

70.___ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.
___ The misery and suffering caused by the war in Vietnam are not worth its benefits.

71.____ As the National Liberation Front already has the political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.
____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.

72.____ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick which will enable the Viet Cong to take over the country.
____ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.

73.____ The U.S. must negotiate from a clear position of military strength rather than weakness.
____ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.

74.____ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.
____ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.

75.____ Because right may be more important than peace, war may be the lesser of two evils.
____ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.

76.____ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.
____ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.

77.____ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.
____ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.

78.____ The misery and suffering caused by the war in Vietnam are not worth its benefits.
____ As the National Liberation Front already has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.

79.____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.
____ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick which will enable the Viet Cong to take over the country.

80.____ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.
____ The U.S. must negotiate from a clear position of military strength rather than weakness.

81.____ Even if someone feels that the war in Vietnam is not justified, he should nevertheless serve at the front or wherever he is needed.
____ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.

82.____ Unfortunately the Vietnamese people must suffer in order that others may be spared the ravages of guerilla terrorism.
____ Because right may be more important than peace, war may be the lesser of two evils.

83.____ The security of the U.S. is very much related to the security of South Vietnam. A victory now will mean greater security and further assurance of a lasting peace in the future.
____ The U.S. instigated the war in Vietnam by never allowing the free elections promised by the Geneva Convention to take place throughout the North and South.

84.____ It is difficult to imagine any situation in which the U.S. would be justified in sanctioning or participating in another war.
____ By supporting any South Vietnamese government in power, the U.S. has demonstrated that it is only interested in keeping the status quo.

85.____ As the National Liberation Front has political support of a large part of South Vietnam, the U.S. should recognize it as the rightful government.
____ The U.S. has consistently stood for the principle that the people of each country should have the right to determine their own political and social destiny without outside intervention. The defense of South Vietnam gives its people these rights.

86.____ The withdrawal of American troops that Hanoi stipulates as a prerequisite for peace talks is simply a trick which will enable the Viet Cong to take over the country.
____ The misery and suffering caused by the war in Vietnam are not worth its benefits.

87.____ The U.S. must negotiate from a clear position of military strength rather than weakness.
____ There is evidence that the U.S. is supporting an unpopular government in South Vietnam.

88.____ The U.S. certainly did not appreciate outside military intervention during its own revolution and should not intervene in the revolutions of other countries.
____ The Communists must be stopped now in Vietnam rather than at some future time. If Hitler had been stopped earlier, World War II would never have occurred.

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